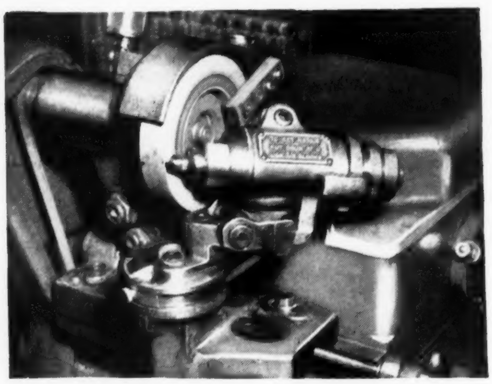
MARCH 1943—FORTY-NINTH YEAR

MACHINERY

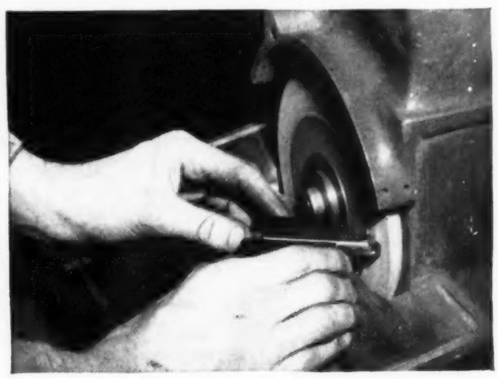
TO GET MAXIMUM TOOL LIFE
PLUS PRODUCTION -- ACCURACY -- FINISH
FROM YOUR BORE-MATIC TOOLS

GRIND TOOLS THIS WAY



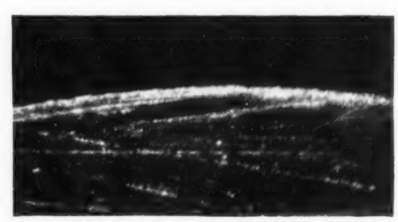
Your single point carbide tools can be quickly lapped exactly to required specifications on the Heald Tool Sharpener — make a few simple adjustments, flick a switch and your tool is correctly lapped, automatically.

NOT THIS WAY

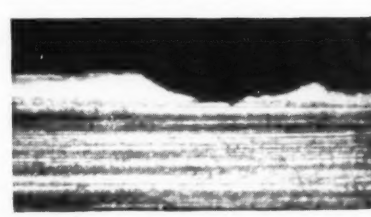


The personal element is bound to be reflected in tools ground free hand. Exact tool shapes are impossible to produce. Undesirable irregularities in the cutting edge cannot be avoided.

Free hand grinding of single-point cemented carbide tools will cut short tool life — and lower production, too. By correctly lapping carbide tools on the Heald Tool Sharpener tool life can be greatly increased since a lapped edge is keener, cuts longer, doesn't break down as fast as a ground edge . . . valuable tool material is conserved because more pieces are produced per sharpening, less material is lost in sharpening . . . better accuracy and finish are obtained as a result of the lapped edge cutting more smoothly, holding its contour longer . . . production is boosted because time lost in resharpening and replacing tools is measurably reduced. Such results cannot be obtained by grinding tools free hand — they must be mechanically lapped on a diamond wheel. Only by positively controlled diamond lapping can absolute regularity of cutting edge and exact nose radii, rake, shear and clearance angles be consistently reproduced. The Heald Tool Sharpener is designed to sharpen tools this way — quickly and inexpensively. Complete details gladly sent on request.



Photomicrograph of tool point lapped with fine grit diamond wheel on Heald Tool Sharpener. Magnification 100X. Note the absolute regularity of cutting edge. This means longer tool life, better finish and accuracy, increased production.



Photomicrograph of tool point ground free hand with fine abrasive wheel. Magnification 100X. Irregularities in cutting edge result in localized stress concentration, then breakdown of the cutting edge and rapid wear.

THE HEALD MACHINE CO. WORCESTER MASS. U. S. A.

DESIGN, CONSTRUCTION, OPERATION OF METAL-WORKING AND ALLIED EQUIPMENT

MACHINERY

April MACHINERY—the Ordnance Production number—will present outstanding articles on munitions manufacture obtained through the cooperation of the Ordnance Department of the United States Army. Among the subjects covered in this up-to-the-minute report on Ordnance Production will be the manufacture of small-arms ammunition in a huge new plant noted for its efficient methods; the forging and machining of gun barrels for tank and anti-tank guns; the production of 155-millimeter shells—from forging through finishing; and methods developed for manufacturing 1000-pound bombs on a mass production basis. April MACHINERY will be of lasting value to executives and shop men closely affiliated with the war effort.

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Number 7

MARCH, 1943

PRINCIPAL CONTENTS OF THIS NUMBER

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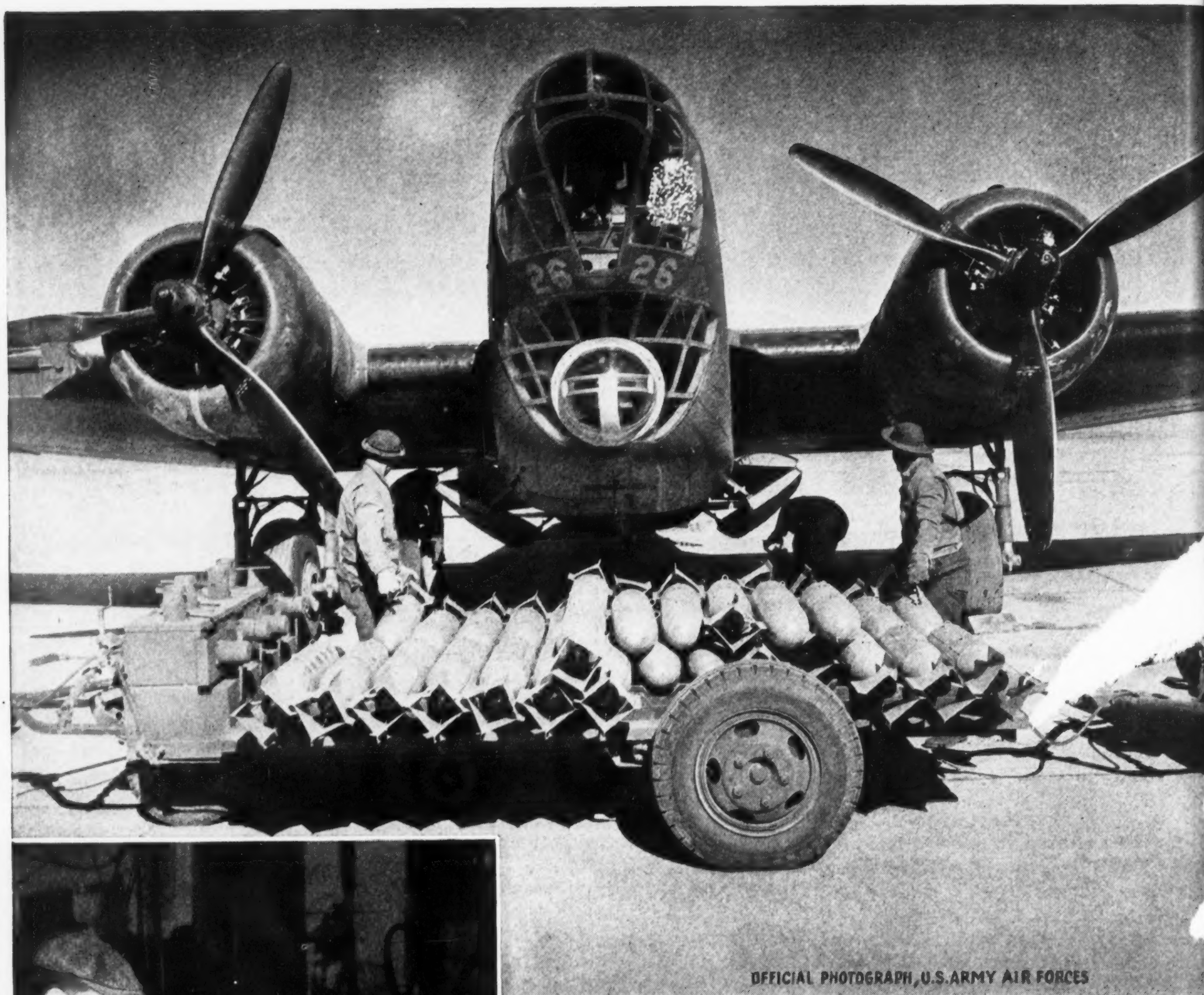

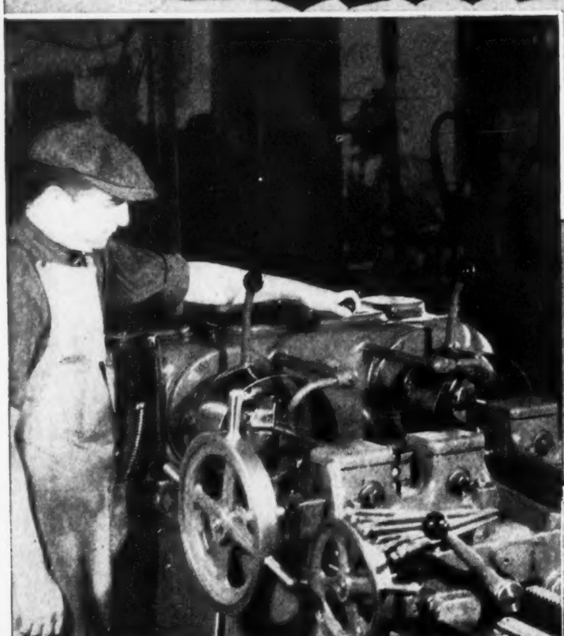

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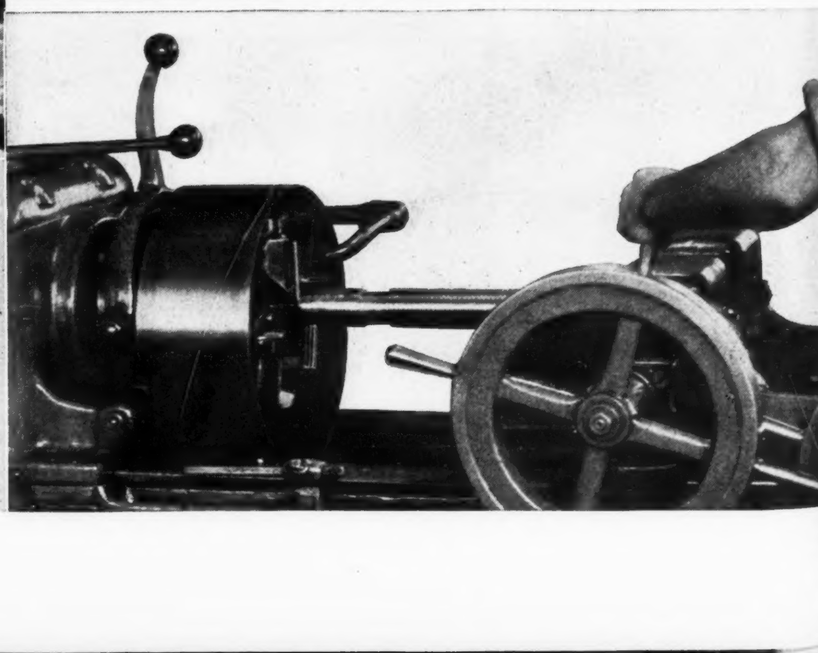

For high production and accurate threading of vital components used in the manufacture of war material, Landmaco Threading Machines and Landis Die Heads are setting new performance records.

Photo U. S. Army Signal Corps

Drilling and Tapping Fuse Bodies

A Detailed Account of the Operations Performed on Kingsbury Machines in Drilling and Tapping Fuse Bodies Used on Shells for the American Army

SHELLS and fuses are being manufactured in million lots to supply the volume in which these are used in modern warfare. Because of the quantities in which they are manufactured, it is necessary in the production of both shells and fuses to employ, as far as possible, automatic or semi-automatic equipment that will produce accurately at high speed.

This article deals with the sequence of operations and the tooling equipment used in per-

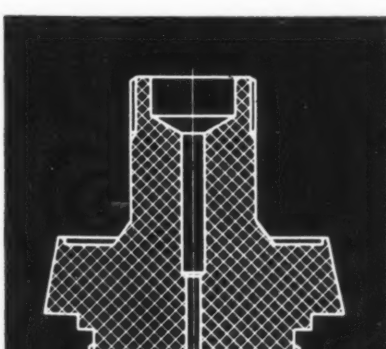

Fig. 1. Fuse Body as It Comes from the Automatic Screw Machine

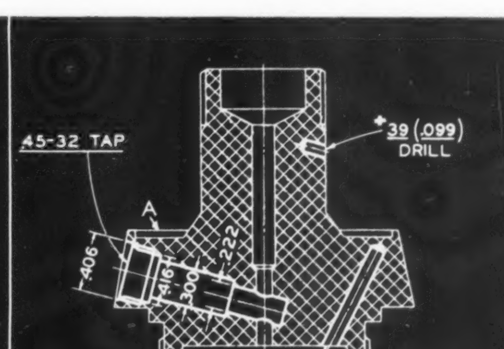

Fig. 2. Holes Drilled and Tapped in the First Cycle of Operations on Fuse Body

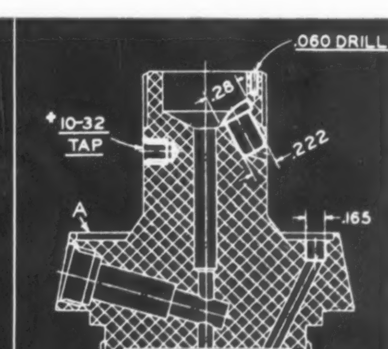

Fig. 3. Holes Drilled and Tapped in Second Cycle of Operations

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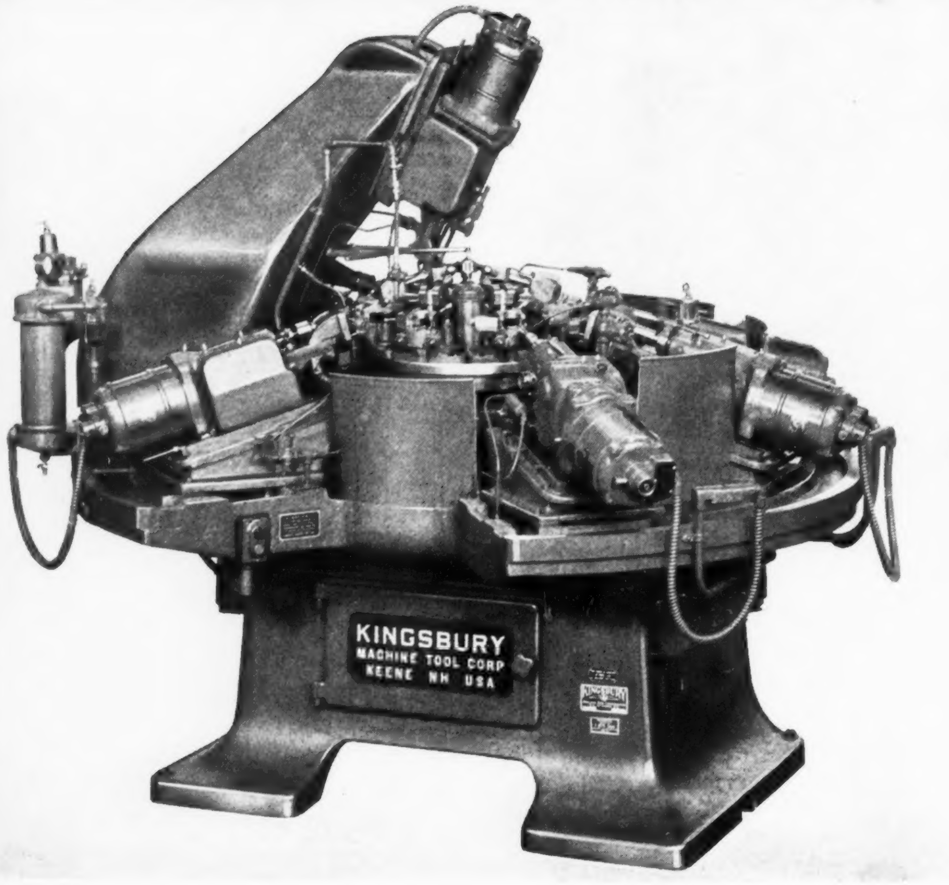


Fig. 4. Kingsbury Machine Arranged for Performing the First Cycle of Operations on Fuse

forming the drilling and tapping operations on U. S. Army fuses on machines made by the Kingsbury Machine Tool Corporation. The cycle of these machines is entirely automatic, the operator merely inserting the fuse blank and removing it after the cycle is completed. The machine on which the work is done is standardized as far as the driving and indexing mechanisms are concerned. Tool-heads and work-holding fixtures are placed on the table of the machine in accordance with the requirements of each job.

Fig. 1 shows a fuse body as it comes to the Kingsbury machines from the automatic screw machines; Fig. 2 shows the holes drilled, counterbored, and tapped in the first cycle of operations; and Fig. 3, the holes drilled, counterbored,

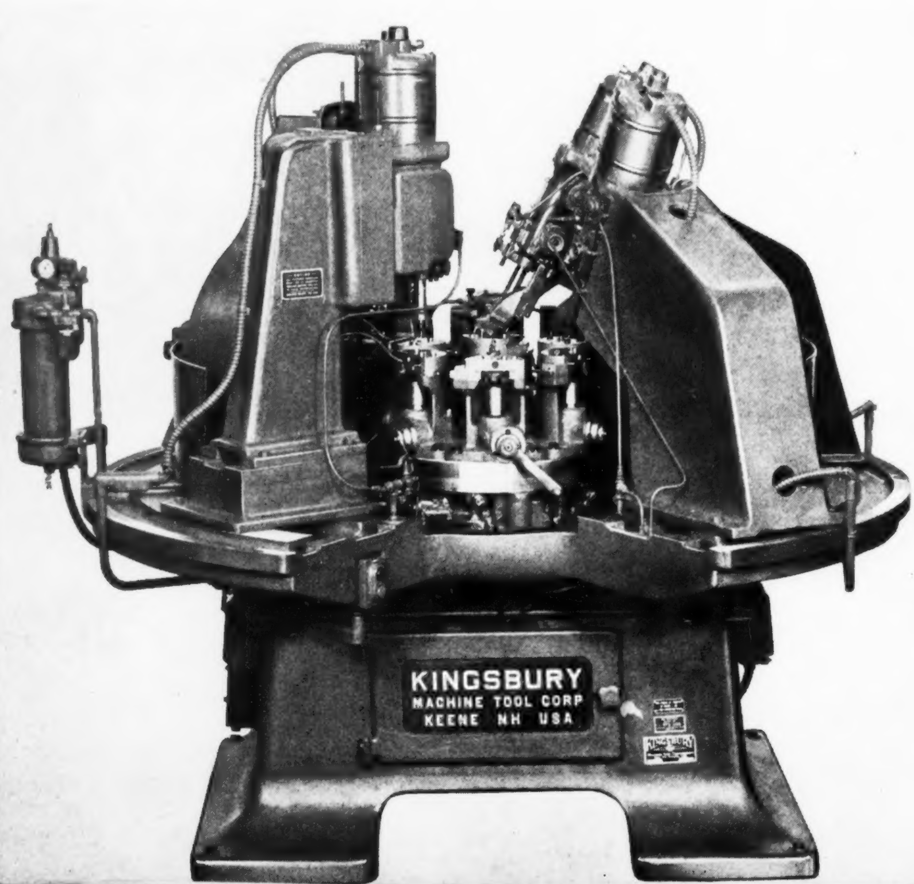


Fig. 5. Kingsbury Machine Tooled for Performing Second Cycle of Operations on Fuse

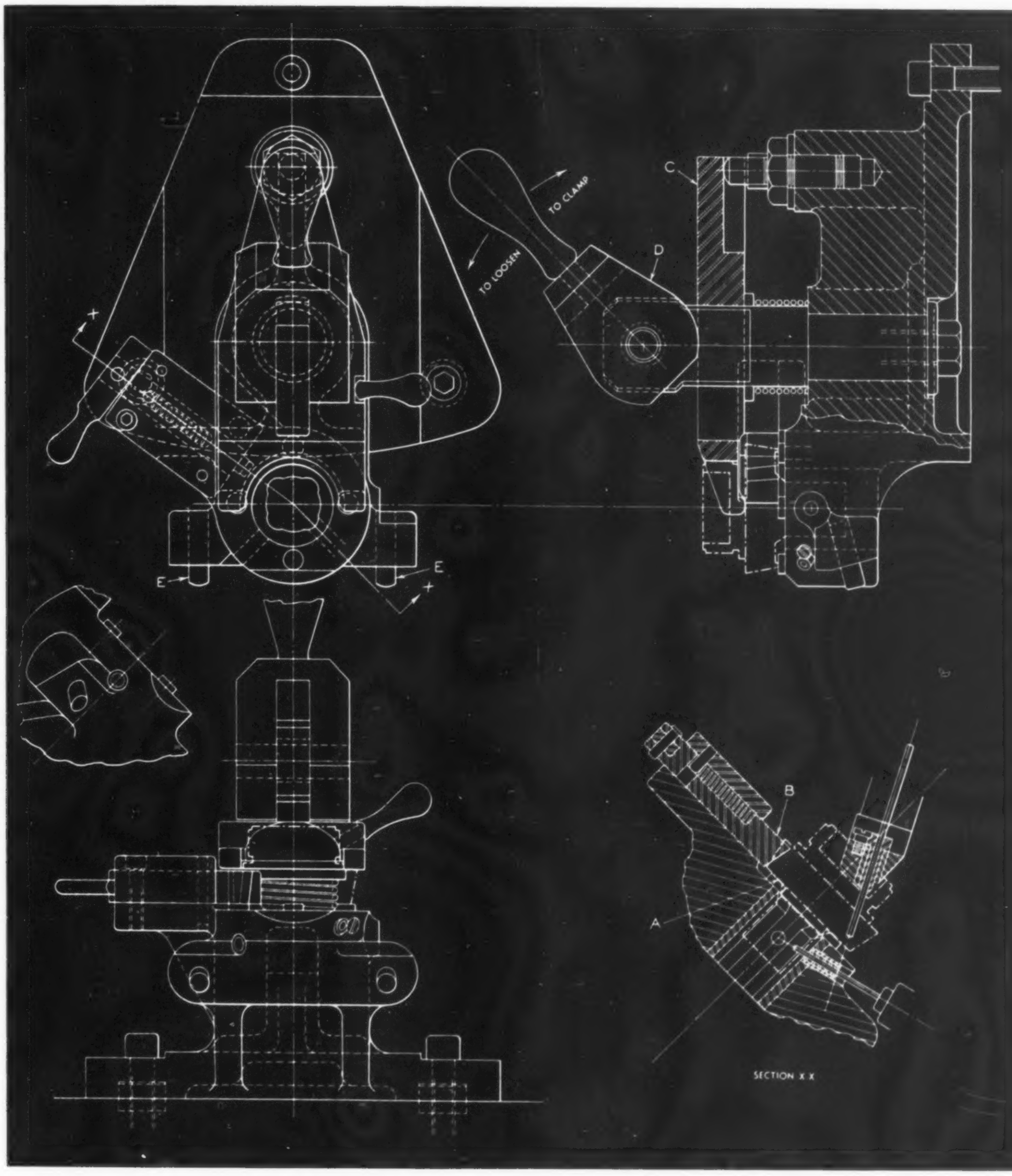


Fig. 6. Fixture for Holding Fuse during First Cycle of Operations

and tapped in the second cycle of operations. A machine equipped for performing the first cycle of operations is shown in Fig. 4, and a machine equipped for the second cycle of operations in Fig. 5.

The fixture for holding the work in the first cycle of operations is shown in Fig. 6, and the arrangement of the drilling and tapping heads in Fig. 7. Fig. 8 shows the fixture for holding the fuse body in the second cycle of operations, and Figs. 9 and 10, the design of the spindles for those operations.

The fuse body to be operated upon is made from aluminum. As mentioned, it comes to the Kingsbury machines directly from the automatic screw machines. In the fixture shown in Fig. 6, used in the first cycle of operations, the fuse is held upside down, as compared with the position in which it is shown in Fig. 2. It is located in the fixture by the diameter of the stem and by

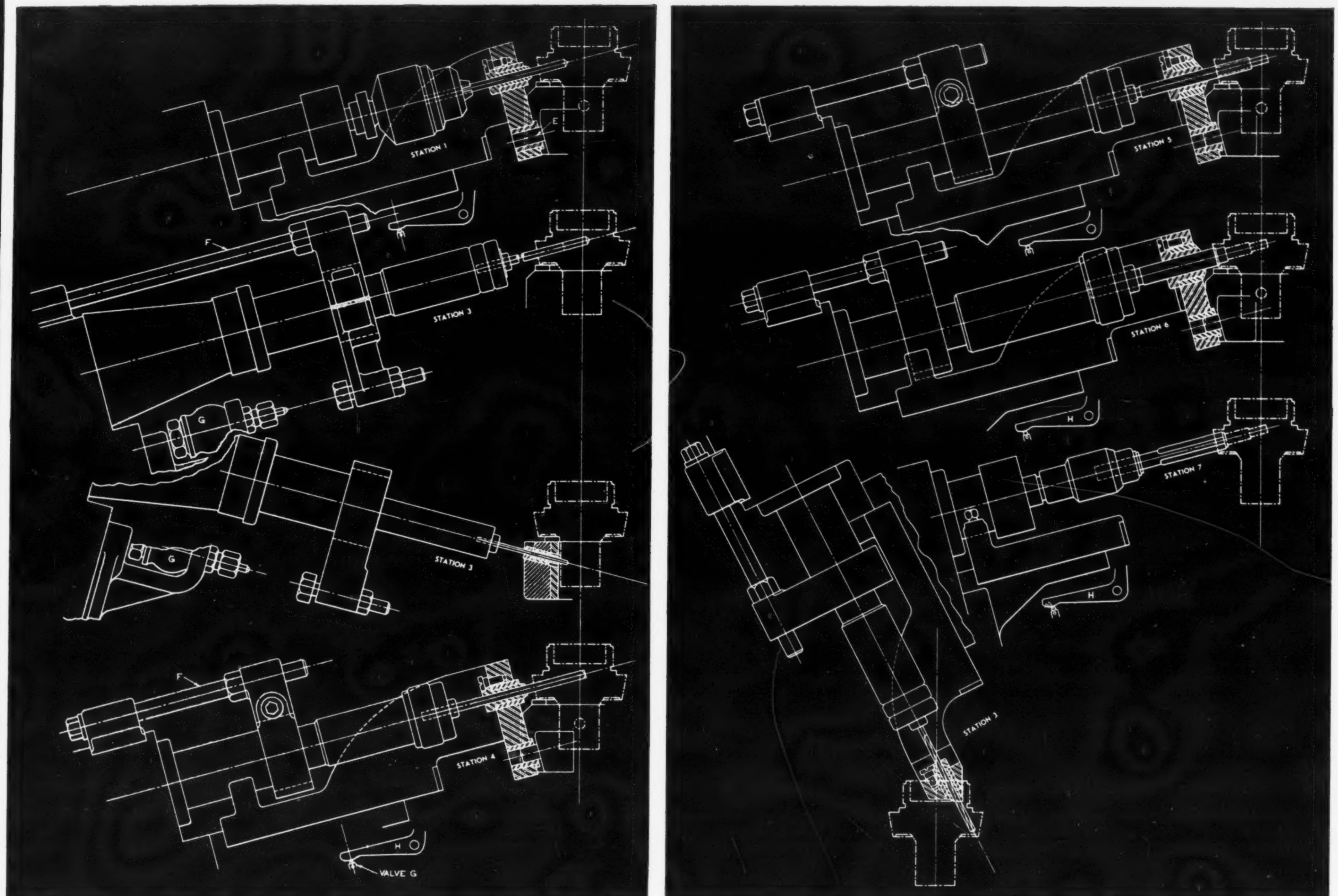


Fig. 7. Lay-out of Tooling Equipment for First Cycle of Operations on the Fuse Body

Fig. 7. Lay-out of Tooling Equipment for First Cycle of Operations on the Fuse Body

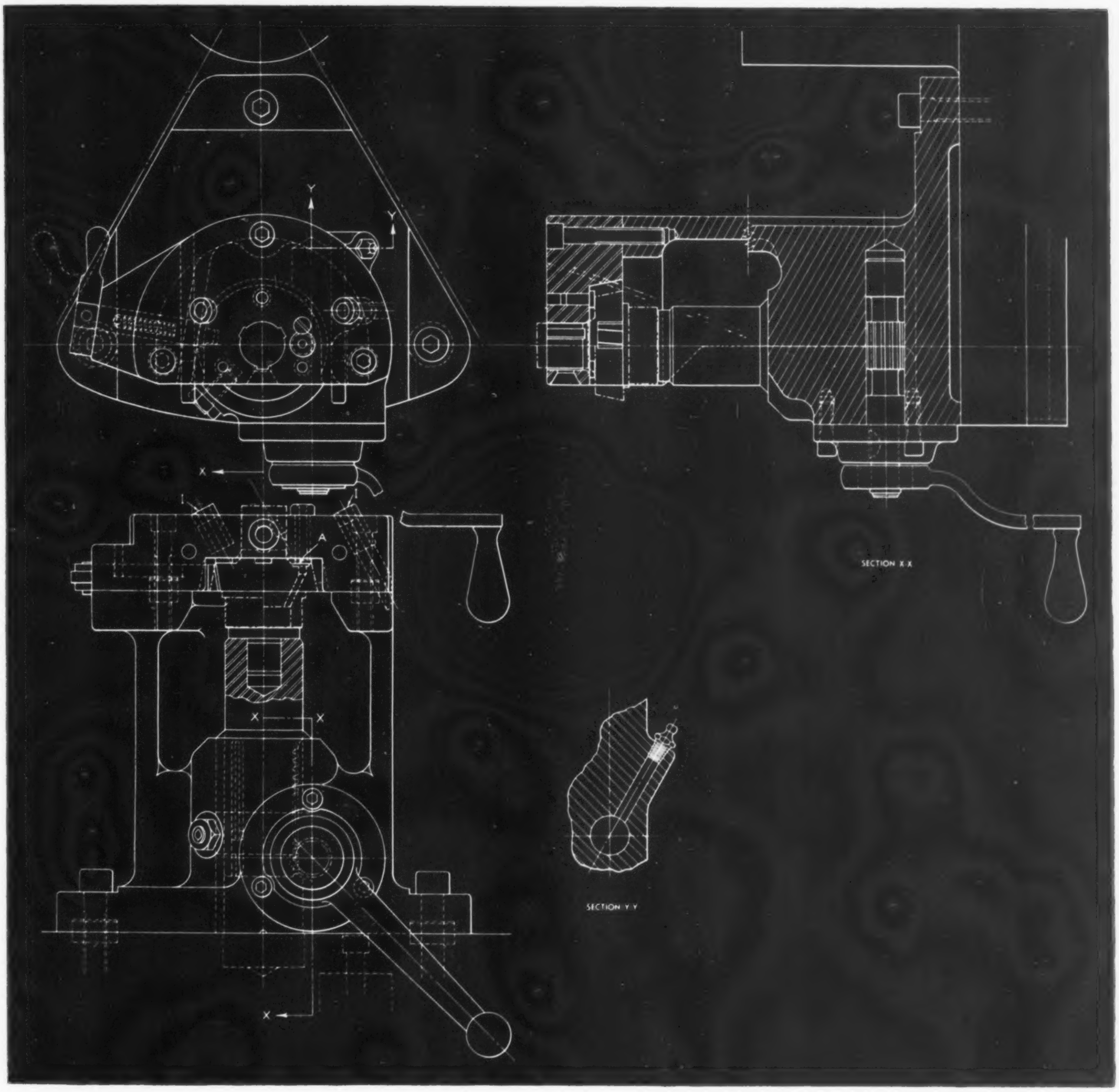


Fig. 8. Fixture for Holding the Fuse during the Second Cycle of Operations

the shoulder *A*. It is also located radially by a plunger *B*, which enters a slot in the tapered part of the body. After the fuse has been properly located, it is clamped in position by a sliding strap *C* and an eccentric *D*.

At the end of a cycle, the operator removes the finished fuse and places a blank in the fixture. Fig. 4 shows clearly the space provided for the operator in the front of the machine and the station at which the machine is loaded and unloaded. The work is then indexed to the first station, where the hole subsequently reamed to a diameter of 0.222 inch (see Fig. 2), is drilled to half-depth, as indicated in Fig. 7. The drill is accurately located and guided by a bushing held in a sliding bushing-bracket which is part of the spindle-holder design, and which, in turn, is located with relation to the fixture by guide pins *E* (Figs. 6 and 7). This bushing-bracket moves in a dovetail slide on the spindle support.

What would normally be the second station is omitted on account of the large head-supporting bracket required at the third station. At this station, the hole drilled to half-depth at the first

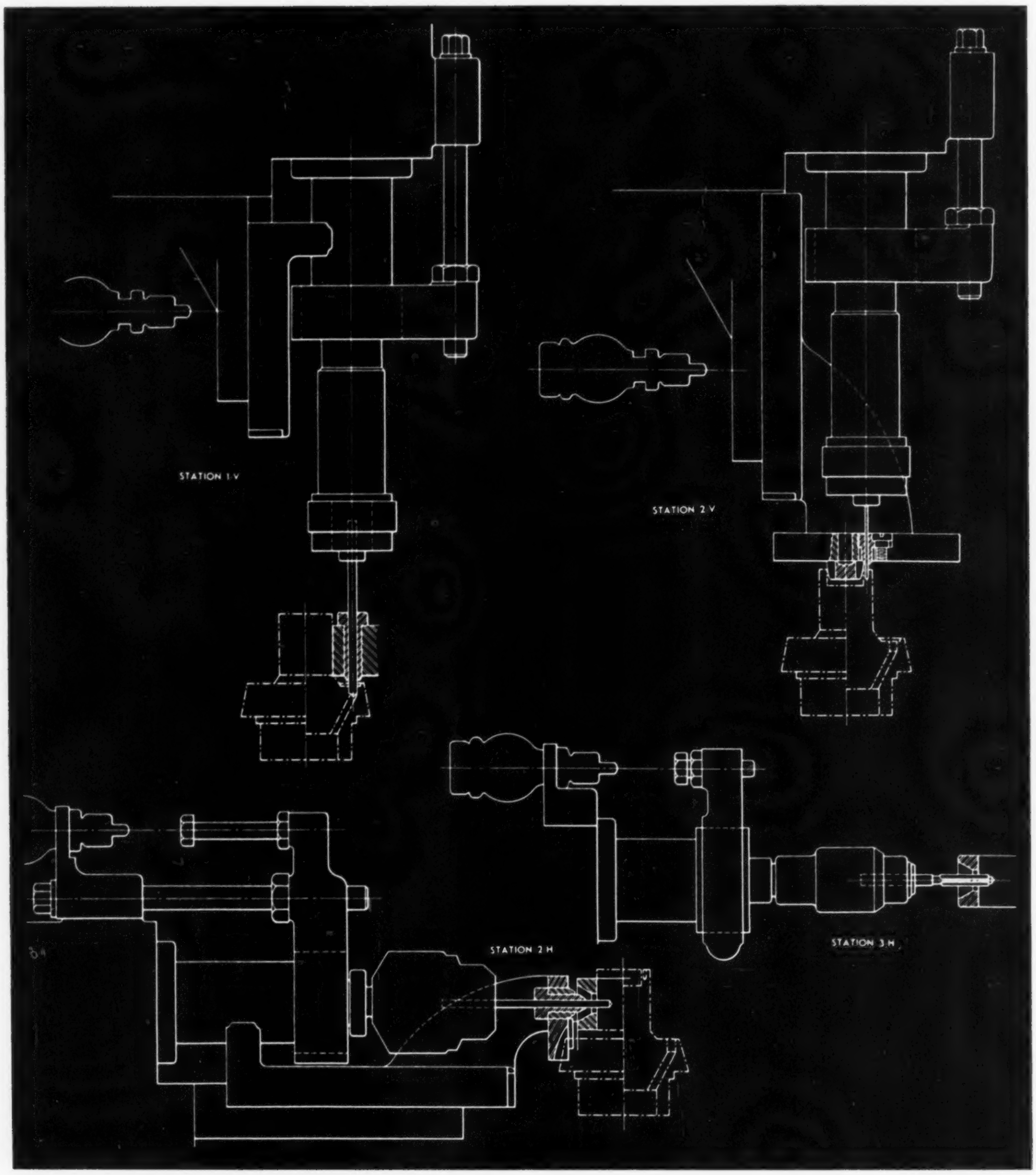


Fig. 9. Part of Tooling Arrangement for Second Cycle of Operations

station is drilled to full depth. For this drilling, no guide bushing is required, since the drill follows the previously drilled hole. A positive stop *F*, Fig. 7, controls the depth of the hole. The complete arrangement of this stop is indicated in the illustration at the fourth station.

It should be noted that at every station there is a valve *G* which is operated by the head of a screw, as at the third station, or by a lever *H*, as at the fourth station. The operation of these valves permits the indexing mechanism to function. All the valves are interlocked, so that the fixture cannot be indexed until all the heads have moved back and the valves at all the heads have been actuated.

At the third station, there is another head which drills the hole marked "No. 39 Drill" in Fig. 2. The guide bushing for this drill is held in the fixture. This drilling operation finishes this hole. Still another operation performed at

VICTORY

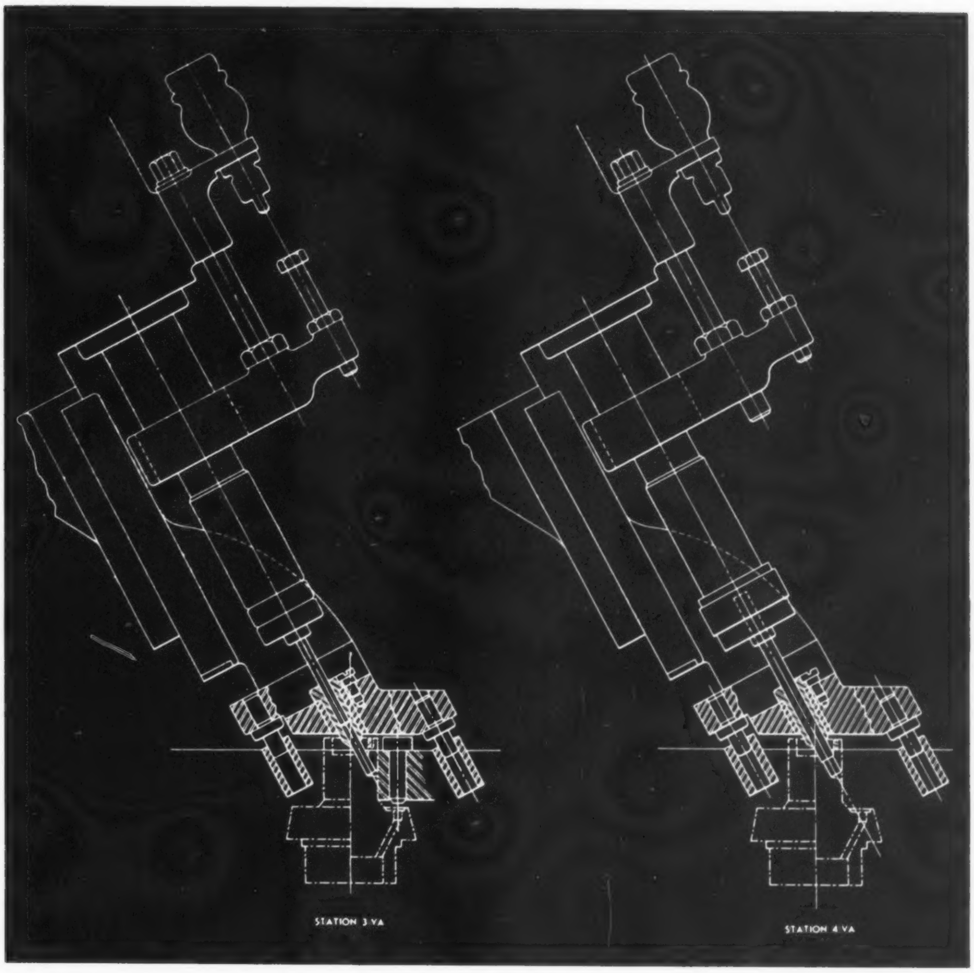


Fig. 10. Additional Tooling Equipment for Second Cycle of Operations

Fig. 11. Another Type of Fuse Body as It Comes from the Automatic Screw Machine

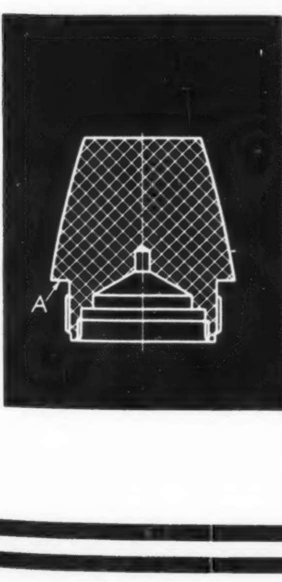
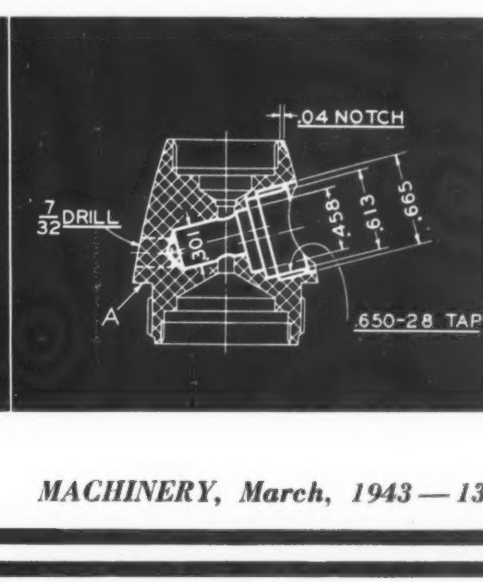


Fig. 12. Drilling, Counterboring, Facing, Chamfering and Tapping Operations to be Performed in First Cycle of Operations

Fig. 13. Drilling and Counterboring Operations to be Performed in the Second Cycle of Operations on This Fuse



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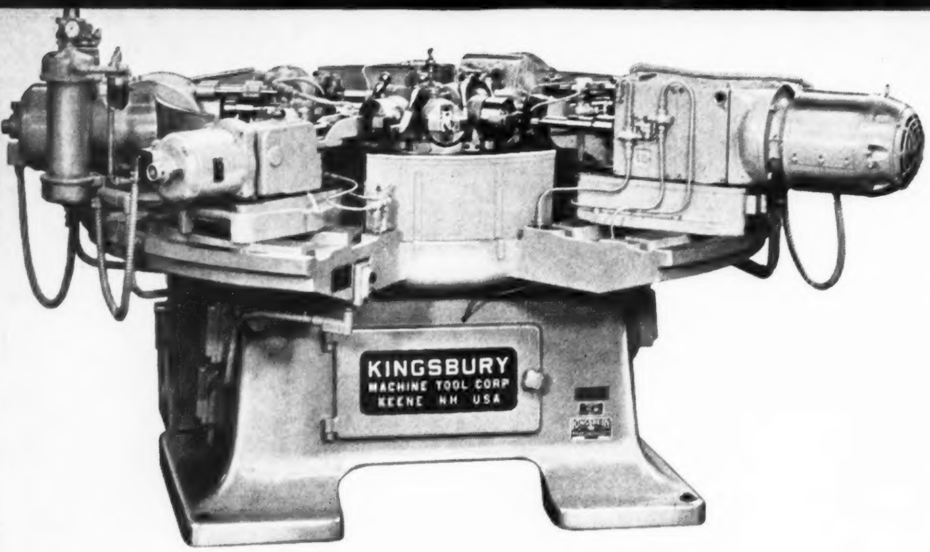

Fig. 14. Kingsbury Machine as Tooled up for First Cycle of Operations on Fuse Shown in Fig. 11

the third station is the drilling of the hole marked "No. 30 Drill" in Fig. 2, which is drilled by a separate head. The bushing-holder comes to rest against a corner of the work, being in contact with the fuse body on the cylindrical surface, as well as at the bottom of the hole. The three heads at the third station all work simultaneously.

We now come to the fourth station. Here the hole, the drilling of which was begun in the first station, is reamed and the end of the hole is finished to a flat surface. A sliding bushing-bracket such as was used at the first station is employed. Positive stop *F* provides for machining to the correct depth. There is a Gairing micro-nut on the spindle by means of which close adjustment is obtained.

At the fifth station, this hole is step-counterbored. This operation finishes both the small hole at the end and the next larger step. The guiding provisions and stops are similar to those already described.

At the sixth station, the 0.406 step (Fig. 2) is counterbored. A step counterbore is used which also counterbores or drills the hole for the 0.45-32 tap. A micro-nut on the spindle, a sliding bushing-bracket, and a positive stop are provided, as at previous stations. This hole is now completed except for tapping, which is done at the seventh station with a reversing head.

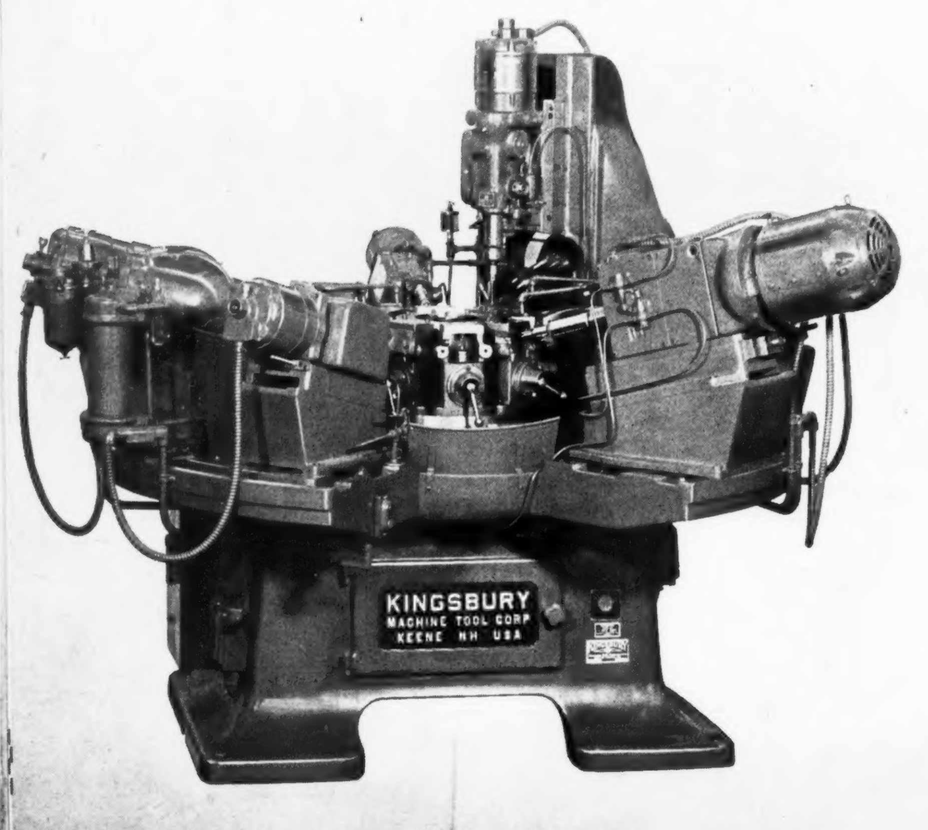

Fig. 15. Kingsbury Machine Equipped for Performing Second Cycle of Operations on Fuse Shown in Fig. 11

The machine on which the second cycle of operations on the fuse body is performed is shown in Fig. 5, the operations themselves being indicated in Fig. 3. The fixture for holding the work during these operations is shown in Fig. 8. In this fixture, the work is held right side up, as compared with its position shown in Fig. 3. The fuse body is located by the same diameter as in the first cycle of operations, and the same shoulder *A* serves as a locating surface, but the clamping is done upward. The work is clamped by means of a rack and pinion, which forces the shoulder on the fuse body against the fixture. Positive clamping is provided for by a Swartz lock, made by the Swartz Tool Products Co., Detroit, Mich. A plunger locates the work radially, as in the first series of operations. The bushing-bracket is provided with pilot-pins for locating the drill bushings accurately, and the fixture is equipped with pilot-bushings *I* for locating the tools of the inclined heads.

The tool-heads are shown in Figs. 9 and 10. Fig. 9 shows the vertical head at Station 1, the horizontal and vertical heads at Station 2, and the horizontal head at Station 3. Fig. 10 shows inclined heads at Stations 3 and 4.

The vertical head at Station 1, Fig. 9, drills the 0.165-inch hole indicated in Fig. 3. The drill is guided by a bushing in the fixture. The head is provided with positive stop and micro-nut depth adjustment.

At Station 2, there are both vertical and hori-

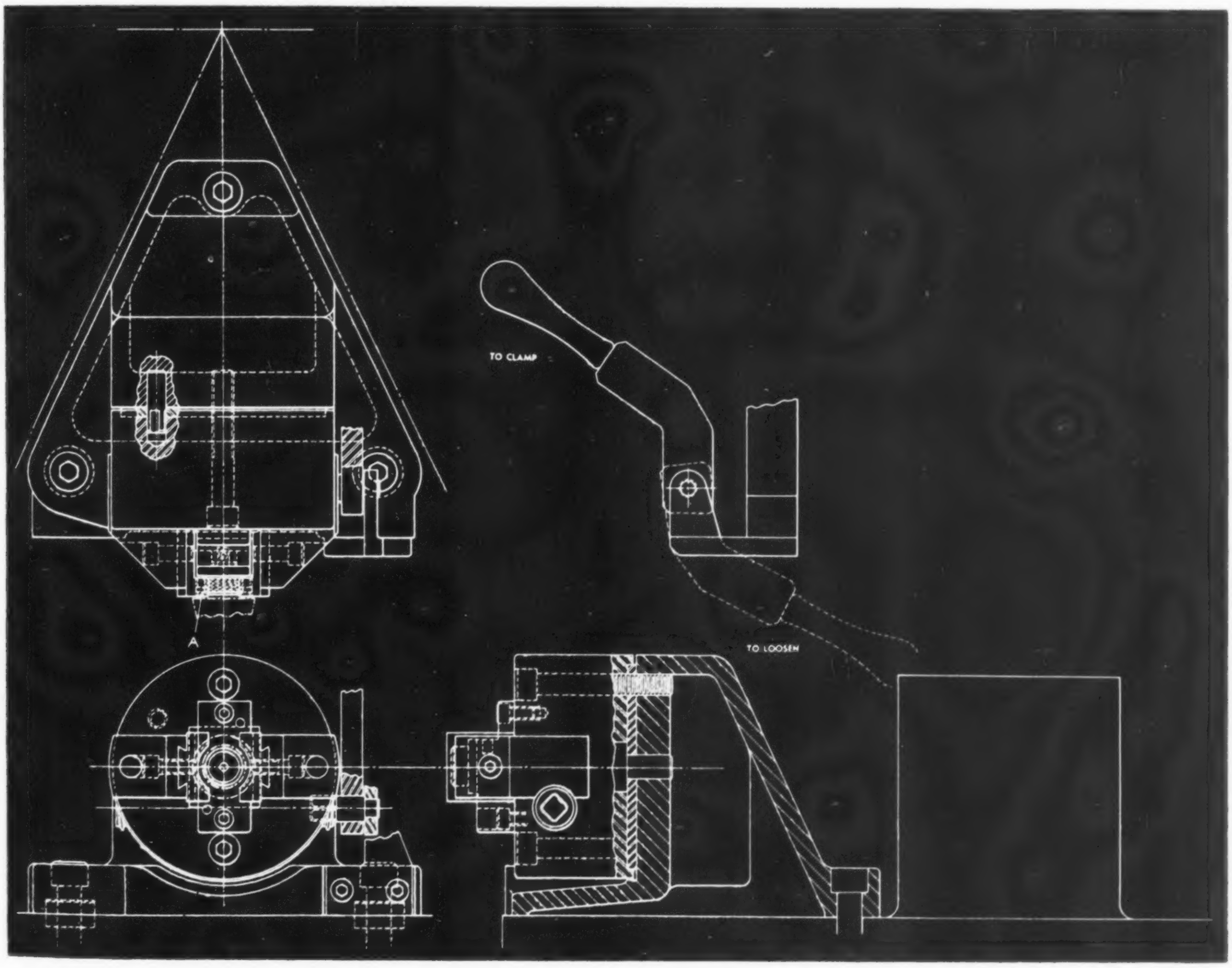

Fig. 16. Fixture for Holding Fuse during First Cycle of Operations

zontal heads, the vertical head being located back of the vertical head at Station 1 in Fig. 5. This head drills the 0.060-inch hole, Fig. 3. The drill guide bushing, held in a sliding bushing-bracket, is accurately located by a tapered plug, also held in the bushing-bracket, the plug being correctly centered by the large hole in the fuse head. This operation finishes this hole.

Simultaneously with this operation, a horizontal head at the second station drills the hole in the side of the fuse body for the No. 10-32 tap (Fig. 3). A depth stop is provided. A bushing-bracket piloted from the fixture by pins holds the drill bushing.

At Station 3, two operations are performed simultaneously. The No. 10-32 hole is tapped by the spindle shown in Fig. 9, and the inclined hole is drilled by the head shown to the left in Fig. 10. This head has a special sliding bushing-bracket piloted by bushings in the fixture. The usual stop is provided to limit the depth of cut, as well as adjusting nuts for the drill spindle.

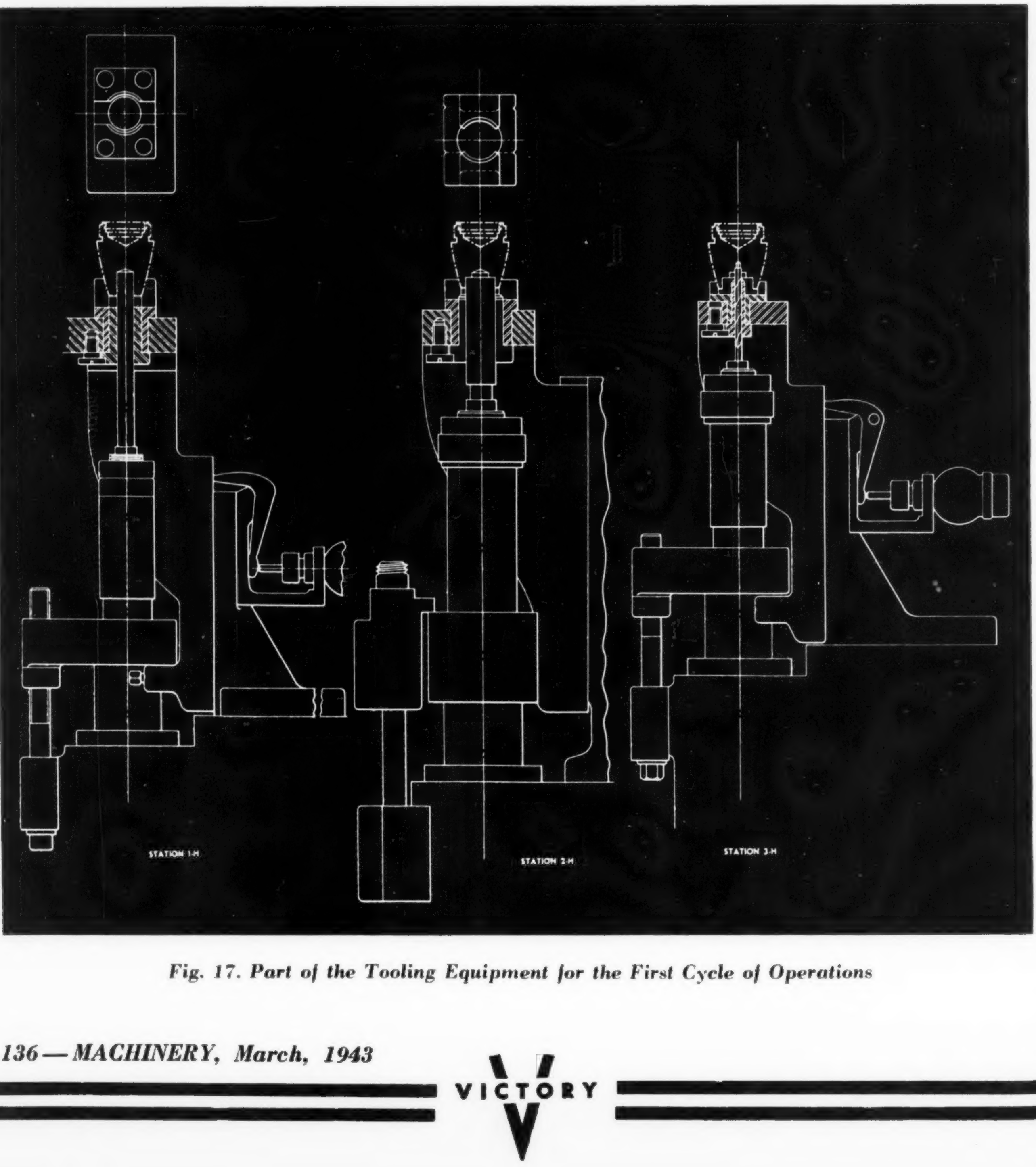

Fig. 17. Part of the Tooling Equipment for the First Cycle of Operations

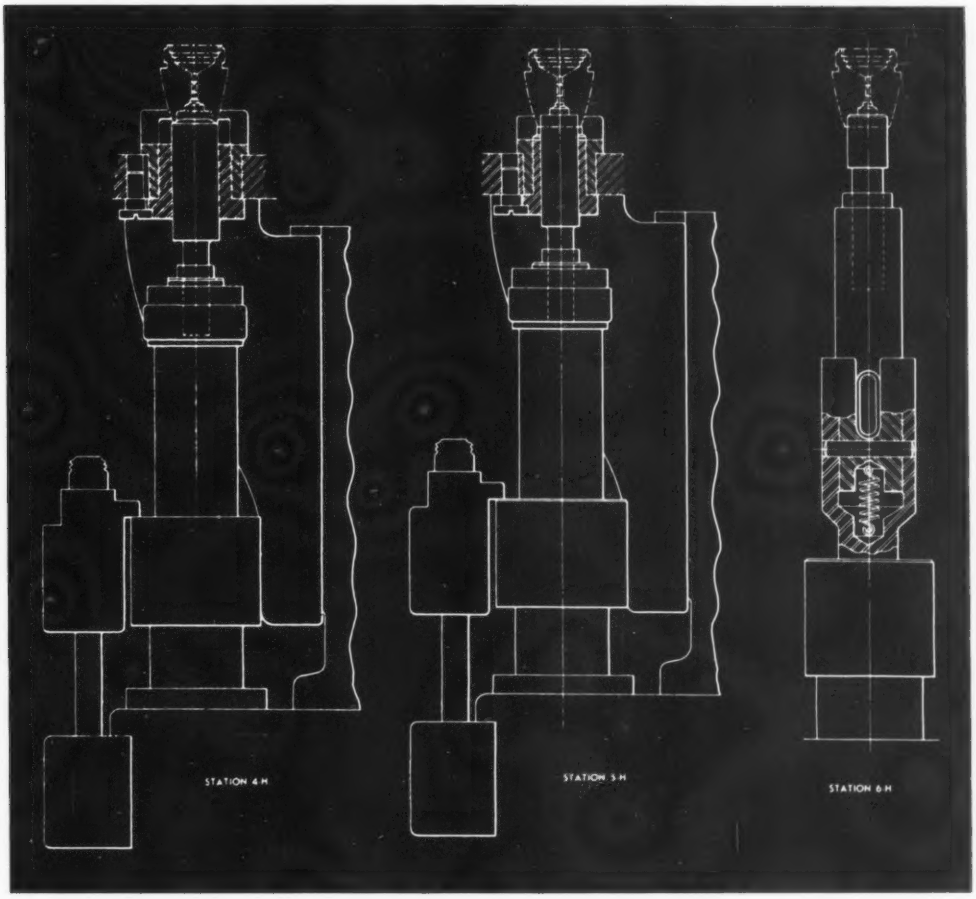

Fig. 18. Additional Tooling Equipment for First Cycle of Operations

Finally, at the fourth station, shown at the right in Fig. 10, the inclined hole is finished. A step counterbore reams the hole already drilled and counterbores it. The bottom of the hole is squared, and a small radius is provided at the bottom. The step counterbore is guided in the same manner as the drill in the head shown to the left; but in this case, instead of adjusting nuts, the spindle is provided with micro-nuts for fine adjustment.

This finishes the drilling and tapping operations on this type of fuse. The operations on another type of fuse body are similar in character, but are somewhat simpler in that there are not so many operations to perform.

The second fuse-body aluminum blank as it comes from the automatic screw machine is shown in Fig. 11. The work performed in the first cycle of operations is indicated in Fig. 12, and that done in the second cycle of operations in Fig. 13. The Kingsbury machine employed for the first cycle of operations is shown in Fig. 14, and the machine employed for the second cycle of operations in Fig. 15. Fig. 16 shows the fixture for the first series of operations, and Figs. 17 and 18 the tooling arrangement for that cycle. The fixture for the second cycle of operations is shown in Fig. 19, and the tooling arrangement in Fig. 20.

The fixture in which the work is held for the first series of operations (Fig. 16) is simply a specially arranged chuck in which the fuse body is held by the threaded portion at the end and located against the shoulder *A*. The threaded portion or stem is held by two jaws of the chuck which are threaded. However, these two jaws, in contrast to usual chuck design practice, are allowed to float about 1/64 inch in the direction

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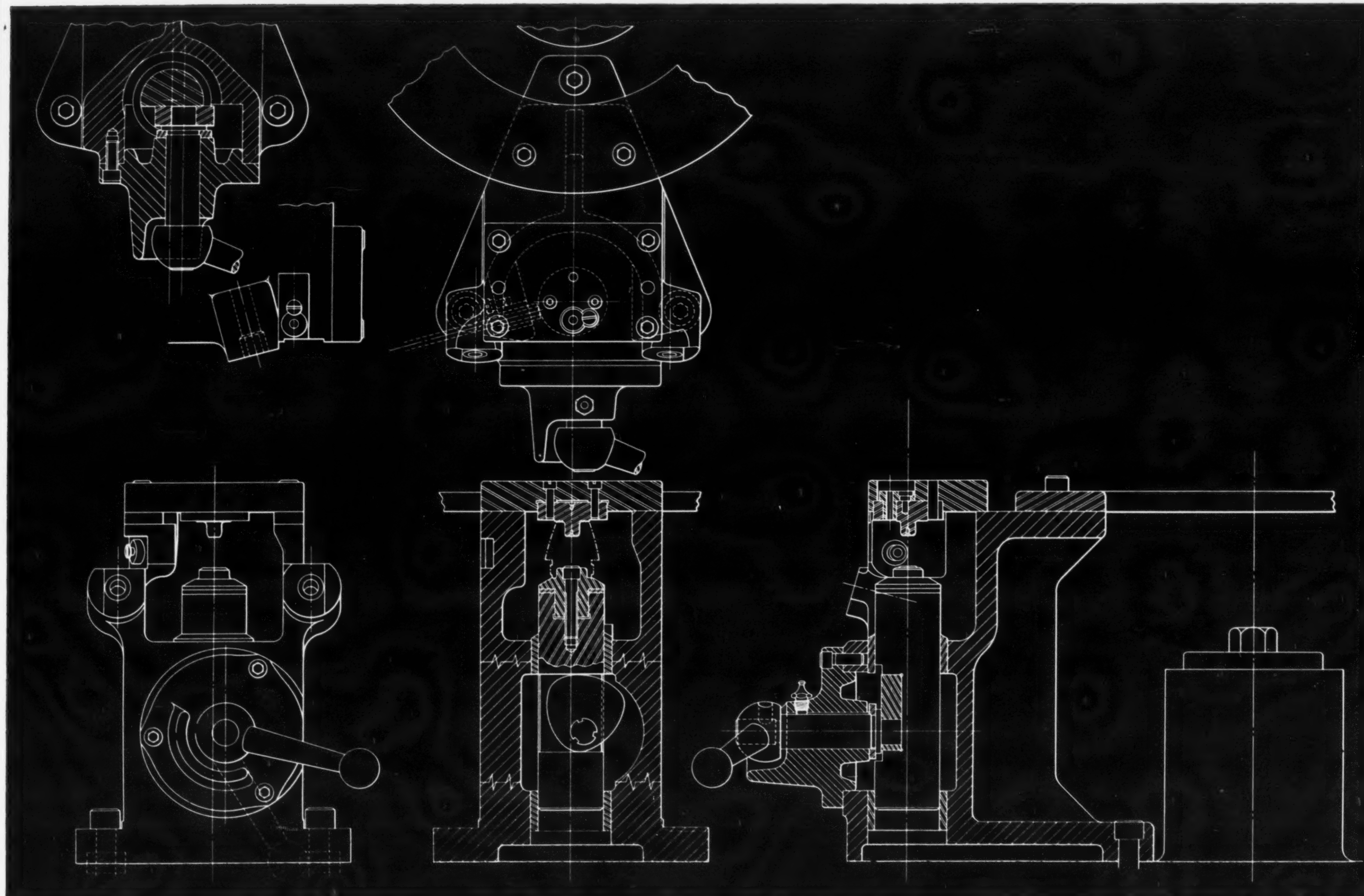


Fig. 19. Fixture for Holding the Fuse Body Shown in Fig. 11 during the Second Cycle of Operations

Fig. 19. Fixture for Holding the Fuse Body Shown in Fig. 11 during the Second Cycle of Operations

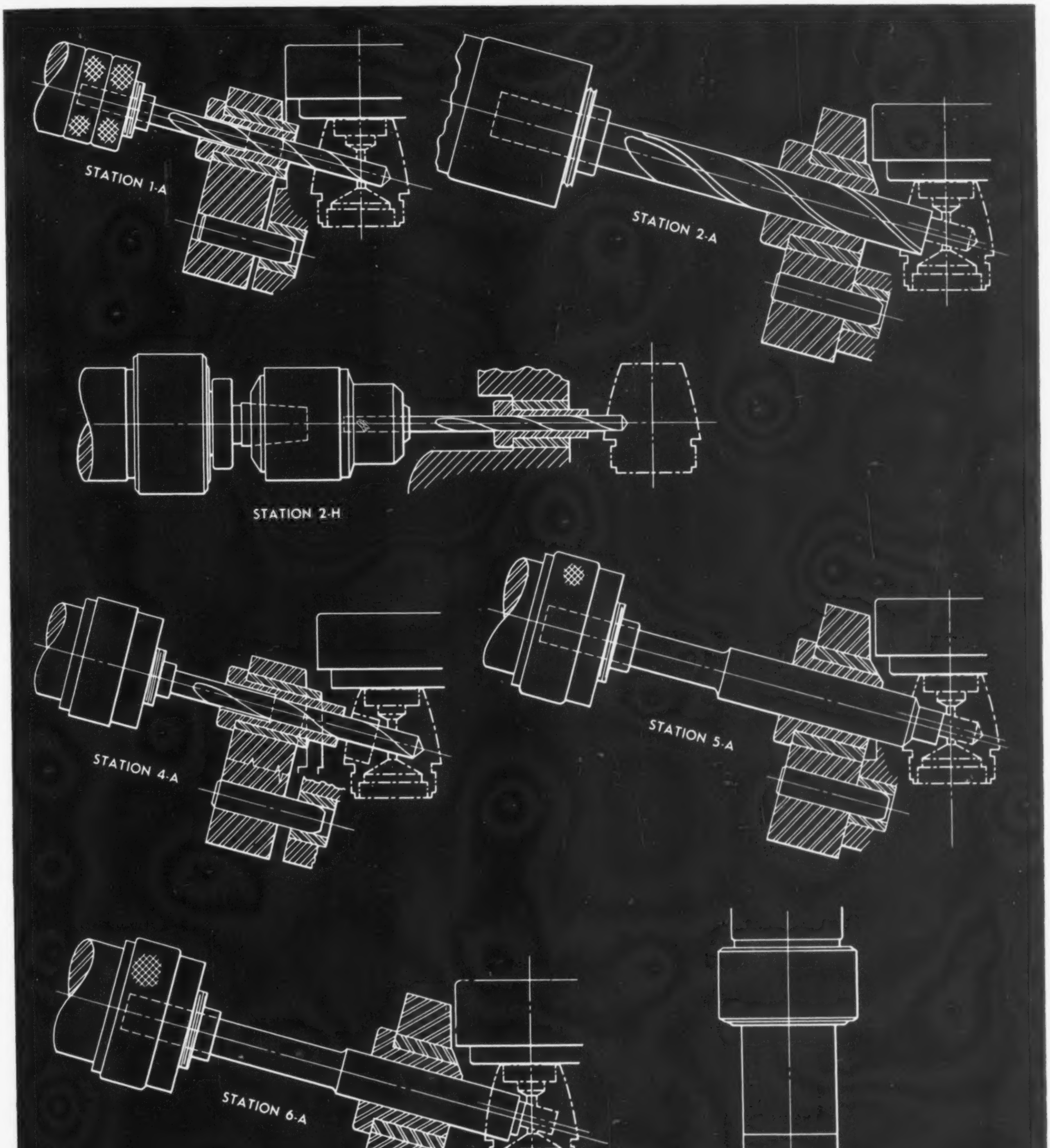


Fig. 20. Tooling Equipment for Performing Second Cycle of Operations on Fuse

of their travel. This floating condition is obtained by narrowing, by 1/64 inch, the key member that holds the clamping screw central on the chuck.

In loading the work into the chuck, the jaws are brought together far enough for a very free fit of the work in the threaded jaws. This is easily accomplished, since the position of the clamping handle can be gaged visually. As there is only about 3/16 inch length of thread in the chuck jaws, the fuse body can be easily screwed into this loose-fitting thread by the operator. A central locating plug in the chuck centers the fuse body and locates it lengthwise from the internal shoulder in the fuse. The operator then clamps the work tightly by means of the chuck jaws, which necessitates a slight additional motion of the clamping handle. In unclamping, the chuck jaws are opened wide, so that the work can be removed directly from the central plug without having to be unscrewed.

It was necessary to limit the inward travel of the two threaded chuck jaws to a position where they would have the true thread diameter of the fuse body. This was accomplished by inserting stop-pins in the central locator. The first operation performed on the end of the fuse tightens it on the threads.

In the first series of operations, the holes shown in Fig. 12 are drilled and tapped. At the first station, the 0.374-inch hole is rough-drilled with a 0.368-inch drill (Fig. 17). The nose of the work centers in a bushing on the drill head. Depth stops and adjusting nuts are provided, as indicated.

At the second station, the 0.707-inch hole (Fig. 12) is counterbored with a 0.695-inch counterbore located in the same manner as at the first station. Here micro-nut adjustment is provided. At the third station, the 0.112- and 0.144-inch holes are step-drilled.

At the fourth station, Fig. 18, the end of the fuse body is faced and the end of the large hole is chamfered. At the fifth station, the 0.707-inch and 0.374-inch holes are step-counterbored to size. At the sixth station, the tapping is performed with a 3/4-24 tap, using a Scully-Jones reversing tap-holder of the tension type.

The fixture for the second series of operations, shown in Fig. 19, holds the work vertically, clamping it from the bottom. A cam-actuated clamp is used; pilot-bushings are provided in the fixture instead of pilot-pins. Bushings had to be used instead of pins to provide clearance for indexing. Also, a guide bushing for the 7/32-inch drilled hole is located in the fixture. The work is located from the small end and from plugs that enter the holes at the ends.

The tooling arrangement, as shown in Fig. 20, is practically self-explanatory after the description of the previous operations on the two fuses. At the first station, the smallest hole is drilled, and this is followed by a counterboring operation at the second station. At this station, the hole marked "7/32 Drill" in Fig. 13 is also drilled. Station 3 is not employed. At Station 4, the small hole is reamed. At Station 5 a step-counterboring operation is performed. While this operation is taking place, the notch indicated in Fig. 13 is cut by a specially pointed drill. Finally, at the sixth station, there is a finish-step-reaming operation, and, at the seventh station, a tapping operation. Note that the 0.301-inch hole (Fig. 13) is offset from the counterbored and tapped holes. This, of course, is taken care of by the location of the guide bushings. This finishes the operations on the Kingsbury machines on this fuse.

VICTORY

Photo, Office of War Information

And Now, Glass Gages!

OUT of wartime necessities has come a development of exceptional interest to manufacturers of metal products that must meet high requirements as to accuracy of dimensions. In order to save large quantities of high-grade steel now being used in manufacturing inspection gages and to save the machine tool time required in finishing gages of this type, both the Government and private industry have turned to glass as a substitute. Months of experimentation have given very satisfactory results, and glass gages are now actually being used in the shop. In fact, on the basis of tests conducted at the Frankford Arsenal, the War Department has intimated that hundreds of thousands of steel gages now being used for the checking of ordnance items will eventually be replaced by glass gages. This will save more than 250 tons of critical tool steel annually in government arsenals alone. The heading illustration shows A. E. Smith and Stanley Farrow (left to right), of the Army Ordnance Gaging Section, discussing the use of glass gages.

A considerable number of glass gages have already been produced by A. H. Heisey & Co., Newark, Ohio. This concern, which has been a manufacturer of high-grade table glassware for more than half a century, was asked by a company in the radio field to make gages of glass. That was in the midsummer of 1942. Upon the successful filling of an order to this radio company, the United States Ordnance Department evinced great interest in this gaging development and sent officers and civilians to the Heisey plant to study the possibilities of widespread application of glass gages. Since then, glass gages of various types have been supplied to both Army arsenals and private industries and

have received enthusiastic endorsement. Besides the Heisey company, the Corning Glass Works, Corning, N. Y., are making glass gages.

Glass gages will not only enable large savings of a critical material and release many machine tools for work other than finishing gages, but they possess many more advantages. Incidentally, about 75 per cent of the total machine tool time that is now consumed in finishing steel gages can be saved by adopting gages of glass. One of the additional advantages is that glass gages provide a visibility in inspection that is not always possible with steel gages. Also, perspiration from the hands of inspectors has no corrosive effect on glass gages, as it has on steel. Whenever steel gages are temporarily taken out of use, it is necessary to grease them so as to prevent corrosion during the idle period, and this grease must be carefully cleaned off before the gages are again returned to inspectors. This greasing and degreasing is unnecessary with glass gages.

As glass has a coefficient of expansion of only 0.000003, glass gages can be handled freely without any chance of their being expanded from the heat of inspectors' hands and their gaging dimensions being affected.

The glass developed for gage use has abrasive resisting qualities equal to or better than those of steel in many applications. It has also been found that where the fits are extra close, so that the size of the work-piece is very nearly that of the gage, there is less tendency for the work to seize or gall on glass than on a steel gage. When scratches occur on a glass gage they do not leave a burr, and the relative size of the gage is unaffected. Glass gages are much lighter than steel gages, and can therefore be more easily handled. Finally, glass gages are only about one-half as expensive as gages made from steel.

If glass gages are dropped on hard surfaces they are, of course, subject to breakage, but they have been chipped on the edges without harmful results to inspected work. Danger of breakage can be reduced by making the gages with handles of hexagon cross-section so as to overcome the tendency to roll when laid down.

In experiments recently conducted in England, it was found that glass plug gages for checking a tapered hole had a life approximately twenty per cent greater than corresponding steel gages. There was a fairly rapid wear of the glass gages during inspection of the first five hundred pieces of work, due principally to a rubbing down of the minute ridges left on the gaging surfaces after lapping. After that, however, wear was slower than on steel gages. By improving the lapping method, better results for the entire life of the gages should be expected. These gages were made of a high silicon glass which is considerably harder than ordinary soda or commercial glass.

The Heisey company manufactures plug and ring gages of several types and sizes, ground to required tolerances. They are pressed in molds. Gages have been made by this concern to an accuracy as close as 0.00005 inch. Single-end plug gages, double-end plug gages, and single-end progressive gages are made in sizes from 0.250 inch to 2.50 inches in diameter. Plain ring and twin ring gages are made in sizes from 0.375 inch to 2.000 inches. All plug gages are made solid with the handle.

Photo, Office of War Information

Single-end and Double-end Plug Gages and a Ring Gage, All Made of Glass

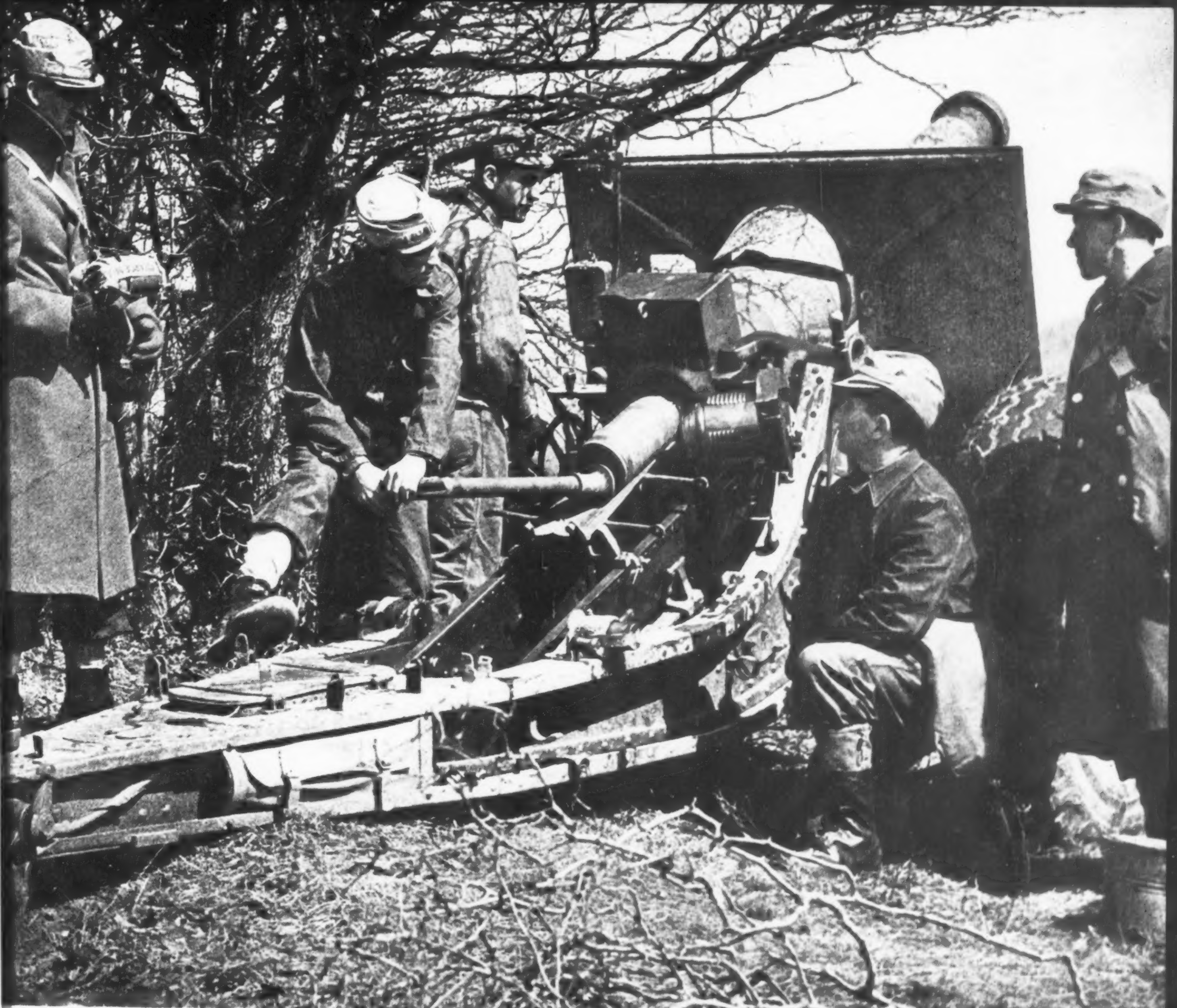


Photo U. S. Army Signal Corps

Automatic Screw Machines in War Production

Examples of Automatic Screw Machine Work on Munitions Parts, Showing Tooling Arrangement and Sequence of Operations as Performed on Acme-Gridley Multiple-Spindle Automatics

AUTOMATIC screw machines—single- as well as multiple-spindle—are playing a most important part in war production, since they are capable of turning out parts with speed and accuracy in great quantities. For that reason, the demand for automatic screw machine work has far exceeded the capacity of the screw products plants throughout the country, and the manufacturers of automatic screw machines are making every effort to supply the additional equipment required.

Since the application of automatic screw machines to war work is so broad, brief descriptions of the tooling arrangement and sequence

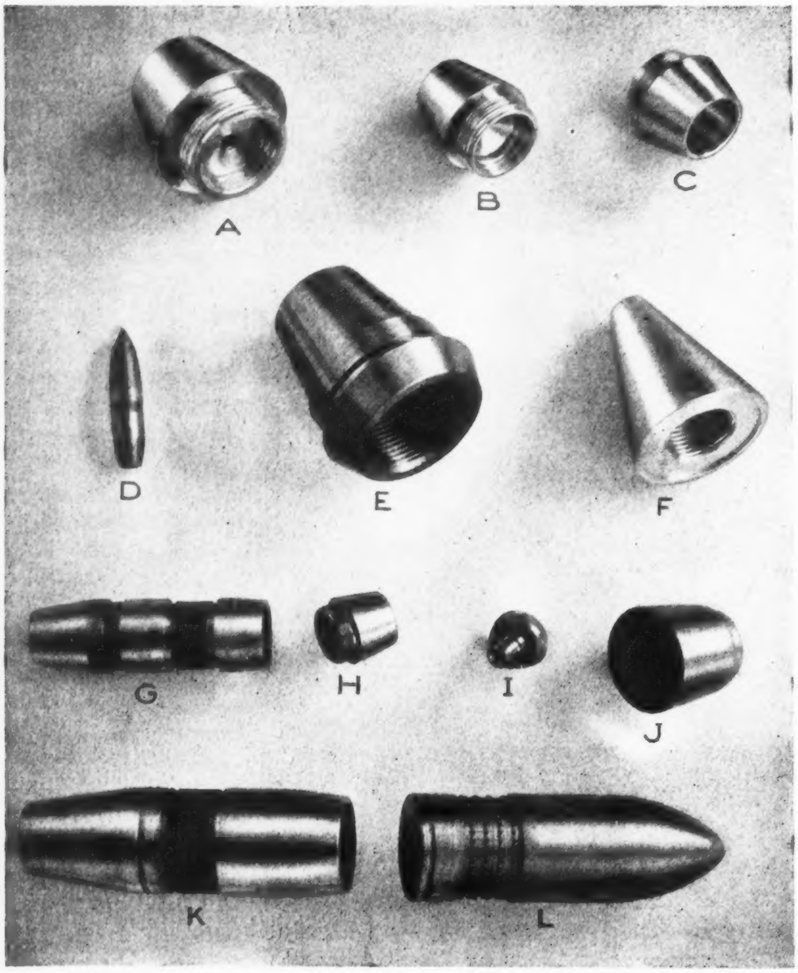


Fig. 1. Munitions Parts Made in Great Quantities on Multiple-spindle Automatic Screw Machines

of operations in making a number of different parts used in connection with fuses, armor-piercing bullets, high-explosive shells, etc., are given in this article, with the view of aiding those who may be comparatively inexperienced in this class of work, but who find it necessary to undertake it as their part in the war production program.

Fig. 1 shows a number of parts used in connection with fuses, high-explosive shells, and armor-piercing cores. The part shown at *A* is made from aluminum, the maximum diameter being approximately 2 inches. It is produced on a six-spindle machine. Fig. 2 shows the order of operations and the machining performed at each spindle position. The illustration is practically self-explanatory, as are most of the tooling set-ups in the examples to follow. The first operation is performed at what is designated the sixth spindle position, and the following operations are then performed in the regular order of the spindles, beginning with the first position. Briefly, the operations at each station are as follows:

Sixth position: Rough-form the outside; drill large hole; face end. For these operations, a circular forming tool, a specially ground drill, and a knee-turner are used.

First position: Semi finish-form the outside and counterbore the large hole. Here a dovetail forming tool held in a dovetail toolholder is used instead of a circular forming tool.

Second position: Face under the head, drill small hole, and turn edge. For this work, a flat facing tool, a standard drill, and a knee-turner are used.

Third position: Finish-form, and tap large hole, using a dovetail forming tool with roller rest and a standard tap in a releasing tap-holder.

Fourth position: Thread the outside and partly cut off, using a plain threading attachment, a self-opening die-head, circular ground chasers, and a standard cutting-off tool.

Fifth position: Counterbore small hole and cut off, using a standard counterbore and regular cutting-off tool.

For performing all these operations, the spindle speed is 1065 R.P.M., and the gross production 400 pieces per hour.

At *B*, Fig. 1, is shown another aluminum part, the largest diameter of which is approximately 1 3/8 inches. The tooling arrangement for this part is shown in Fig. 3. In the sixth position, it is rough-formed and spotted, using a circular forming tool and a straight-shank drill. In the first position, the piece is finish-formed, the end faced, and the large hole drilled, using a dovetail forming tool, a knee-turner, and a straight-shank drill. In the second position, the hole is counterbored for subsequent tapping, which is done in the third position, in addition to the facing of the shoulder and the forming of the neck, which is accomplished with a flat forming tool. Tapping is done by using a universal threading attachment and a releasing tap-holder. In the fourth position, the outside thread is cut with a self-opening die-head and ground circular chasers. The piece is also partly cut off. In the fifth position, the small hole is

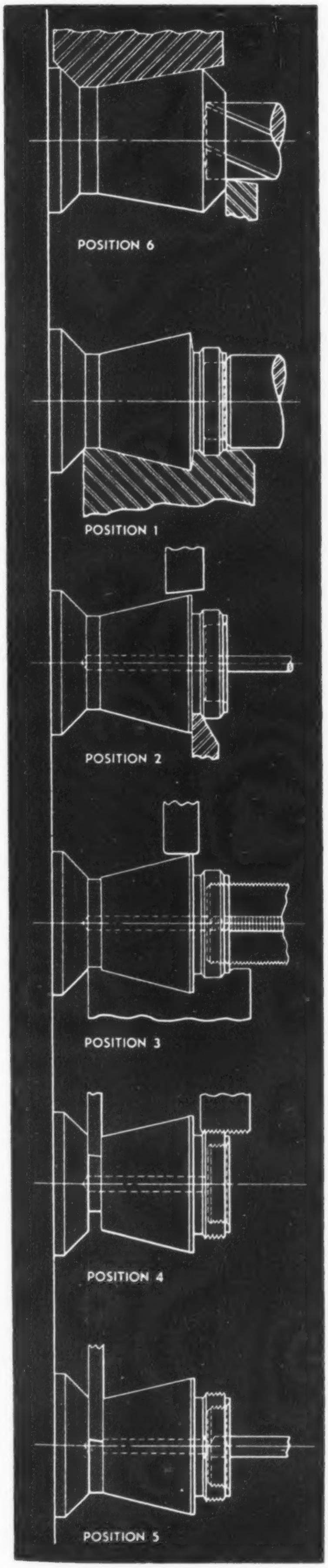


Fig. 2. (Left) Tooling Arrangement for Making an Aluminum Fuse Part on a Six-spindle Automatic

drilled and the piece completely cut off. These operations are performed at a spindle speed of 1168 R.P.M.; the production per hour is approximately 440.

At *C*, Fig. 1, is shown another aluminum part, the largest outside diameter of which is about 1 3/8 inches. This part is produced with the tooling arrangement shown in Fig. 4. Briefly, in the sixth position the part is rough-formed and spotted; in the first, finish-formed, faced at front end, and the large hole drilled. In the second position, that part which is to be threaded is shaved, using a shaving tool and a tool-rest. The small hole is also drilled, using a high-speed drilling attachment.

In the third position, a stencil roll is used for marking, and the large hole is counterbored and squared at the bottom. In the fourth position, the thread is rolled, and the large hole reamed, using a floating reamer-holder. Finally, in the fifth position, the part is cut off. The spindle speed for these operations is 1074 R.P.M., and the production approximately 400 per hour.

Machining 0.50-Caliber Armor-Piercing Steel Cores

Figs. 6 and 7 show a 9/16-inch six-spindle automatic set up for machining the 0.50-caliber armor-piercing steel core seen at *D* in Fig. 1. Fig. 5 shows the sequence of operations, and indicates the machining performed in each spindle position.

In the sixth position, the boat tail is rough-formed and the point turned. The forming of the boat tail is done with a flat forming

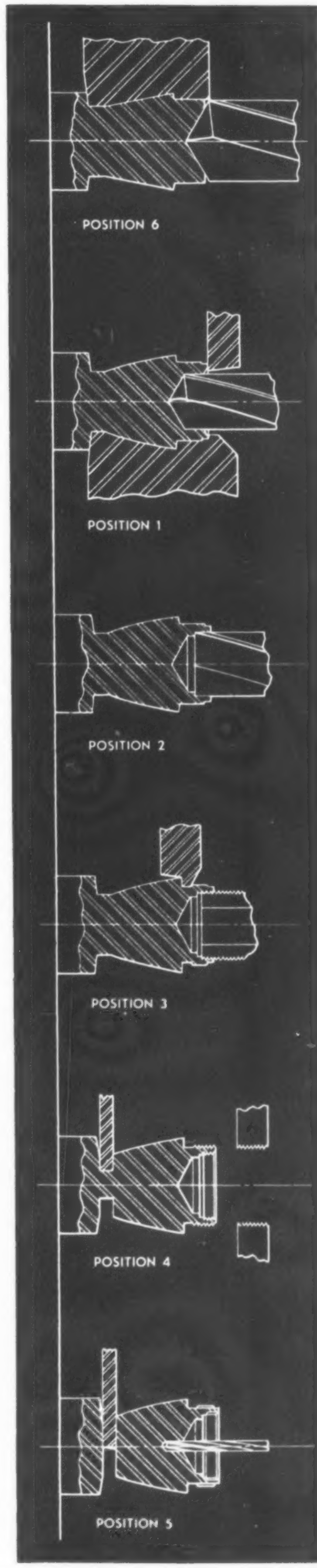


Fig. 3. (Right) Tooling Arrangement for Making Another Aluminum Fuse Part on a Six-spindle Automatic

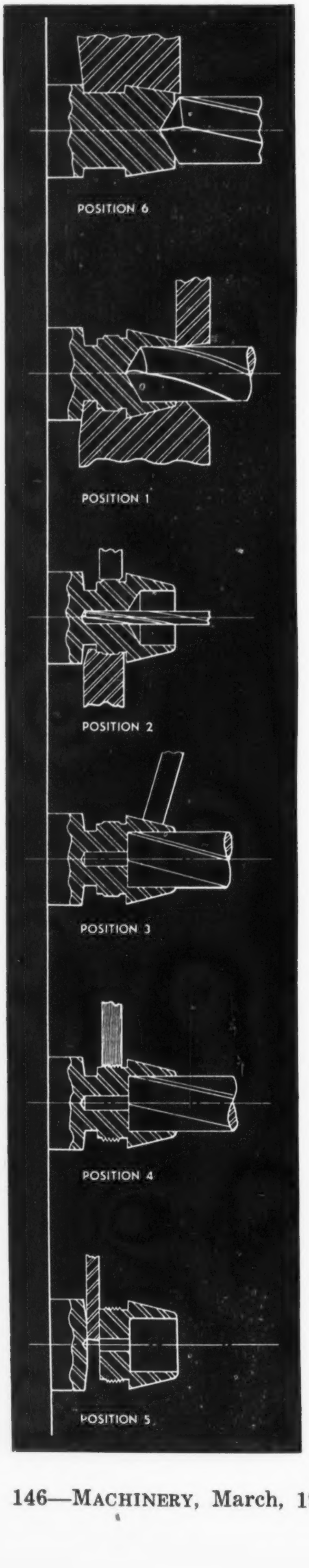


Fig. 4. (Left) Tooling Arrangement for Making an Aluminum Fuse Head on a Six-spindle Automatic Screw Machine

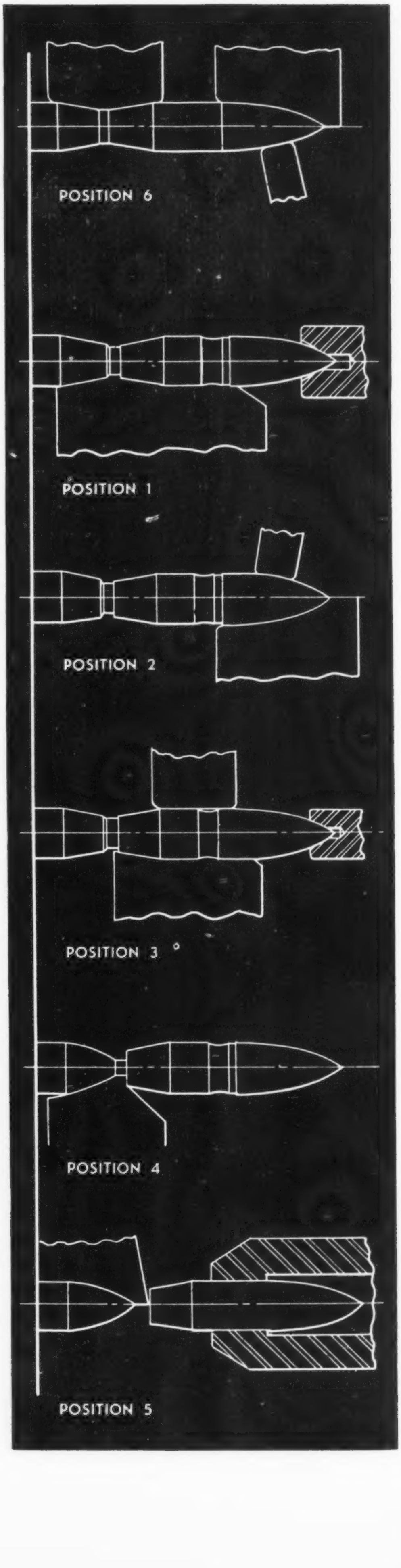
tool. The point is turned by using a roller-turner with a profile tool. In the first position, the body is finish-formed, using a dovetail forming tool, the work being supported at the point as indicated. In the second position, the point is finish-turned, employing a box-turner and a profile tool. In the third position, the body and boat tail are shaved, using a shaving tool, a roller rest, and a support at the point as shown. In the fourth position, a breakdown operation, preliminary to cutting off, is performed with a forming tool. In the fifth position, the core is picked up, as shown, and cut off.

The material used for these armor-piercing cores is a chrome-molybdenum steel. The production per hour is about 550 pieces per machine. The spindles run at 611 R.P.M., giving an average cutting speed of about 75 feet per minute.

Making Steel Adapters on an Eight-Spindle Automatic

At *E*, in Fig. 1, is shown a steel adapter, the largest diameter of which is approximately 2 3/8 inches. This part

Fig. 5. (Right) Tooling Arrangement Employed on Machine Shown in Figs. 6 and 7



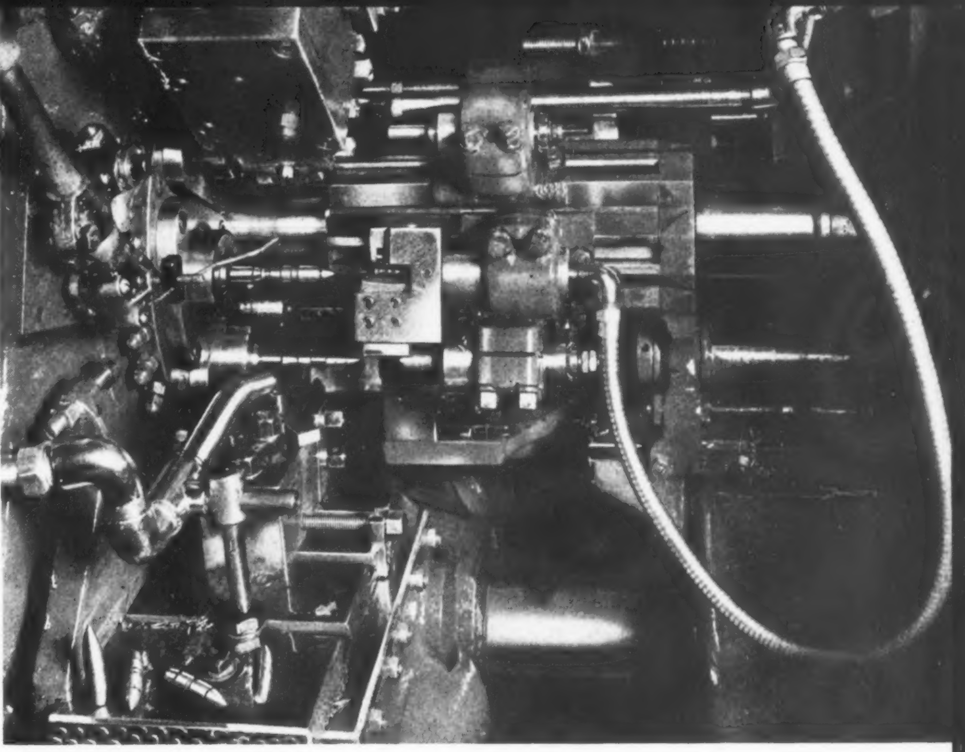


Fig. 6. Front Side of a Six-spindle Acme-Gridley Automatic Provided with Tooling for Making 0.50-caliber Armor-piercing Cores

VICTORY

is made from hot-rolled stock on an eight-spindle machine. The operations are indicated in Fig. 8. In the eighth spindle position, the adapter is partially rough-formed with a circular forming tool, and drilled. In the first position, it is completely rough-formed with a dovetail forming tool, and the hole drilled deeper. In the second position, the front is faced by using a knee-turner, and the smaller hole is partially drilled. In the third position, the smaller hole is drilled through.

In the fourth position, there is a final rough-forming operation with a dovetail forming tool while the large hole is being counterbored. In the fifth position, the outside is finish-formed with a dovetail forming tool, and the smaller hole reamed with an oil-hole type reamer, using an eccelerating reaming attachment. In the sixth position, the large hole is tapped, using a collapsing tap with ground chasers and a plain threading attachment. In the seventh position, the part is cut off. The spindle speed used in performing these operations is 313 R.P.M., and the rate of production is 200 pieces per hour per machine.

At *F*, in Fig. 1, is shown an aluminum closing cap which is made on a six-spindle machine. The operations are, briefly, as follows: Sixth position: Rough-form outside, spot, and face. First position: Semi-finish outside and drill large hole part way. Second position: Finish-form outside and finish drilling the large hole. Third position: Shave outside, drill small hole, and rough-counterbore large hole. Fourth position: Finish-counterbore large hole, face bottom of hole, and ream small hole. Fifth position: Tap large hole and cut off.

The sequence of operations and tooling employed in machining 25-millimeter high-explosive shells on a six-spindle automatic are as follows:

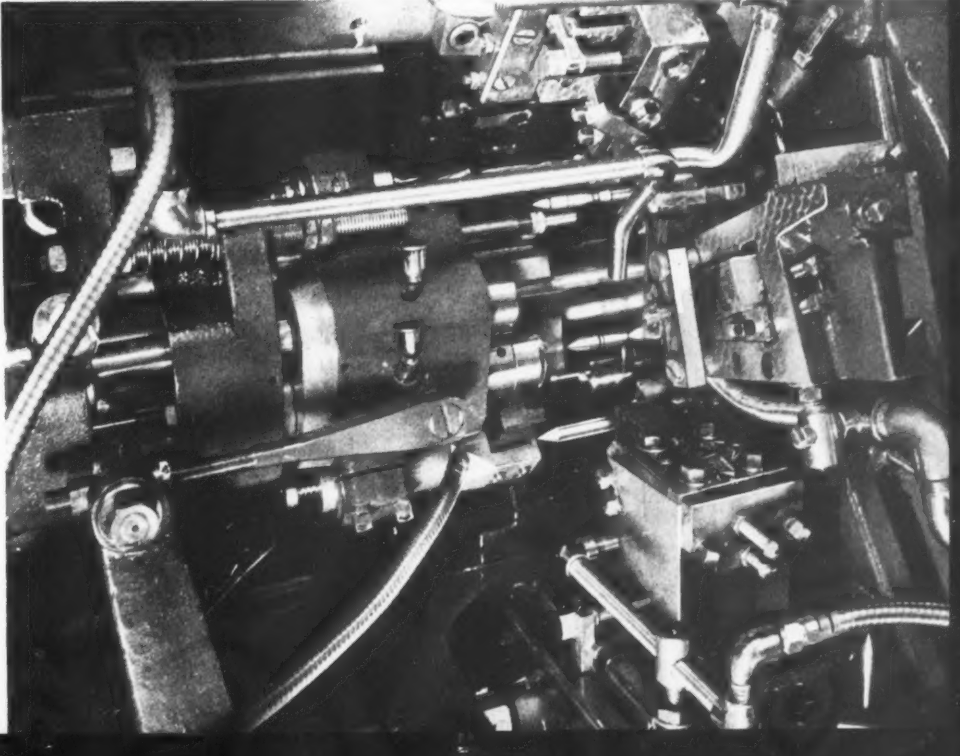


Fig. 7. Rear Side of the Machine Shown in Fig. 6 for Making 0.50-caliber Armor-piercing Cores

VICTORY

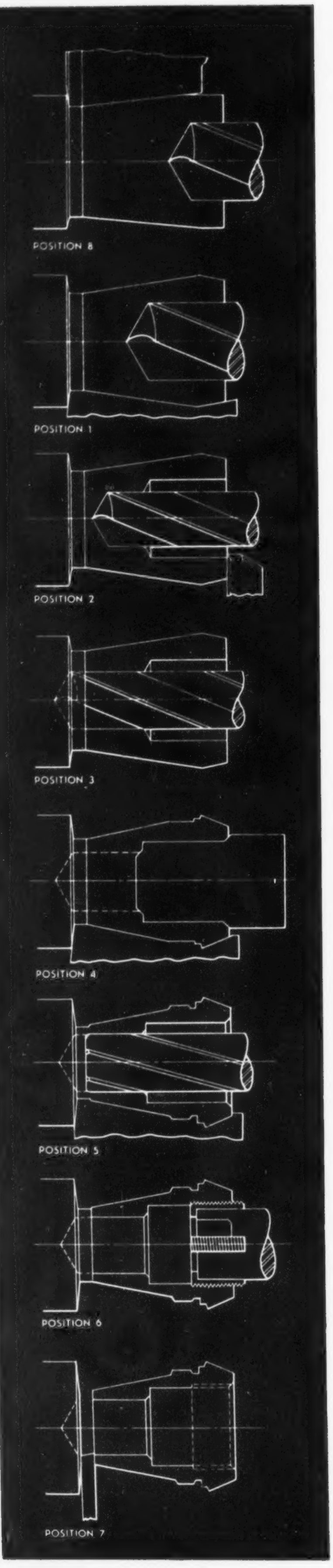


Fig. 8. (Left) Tooling Arrangement for Making a Steel Adapter on an Eight-spindle Automatic Screw Machine

At *G*, in Fig. 1, is shown a 25-millimeter high-explosive steel shell, which is made on a six-spindle automatic as indicated in Fig. 9. The operations for each spindle position are as follows:

Sixth position: Form the rear end of the shell, using a circular forming tool; turn the front end part way, using a knee-turner; drill the large hole in the end of the shell.

First position: Form the rear of the grooves in the shell, using a vertical forming tool; turn the remainder of the shell using a knee-turner; drill the medium-sized hole in the body, using an oil-hole drill.

Second position: Form the front of the grooves in the shell, using a vertical forming tool; form the end of the shell and face the end, using a knee-turner with profile tools; drill the small-diameter hole, using an oil-hole drill.

Third position: Form the internal recess, using a necking tool; form the bottom of the drilled hole, using a drill with a specially formed end.

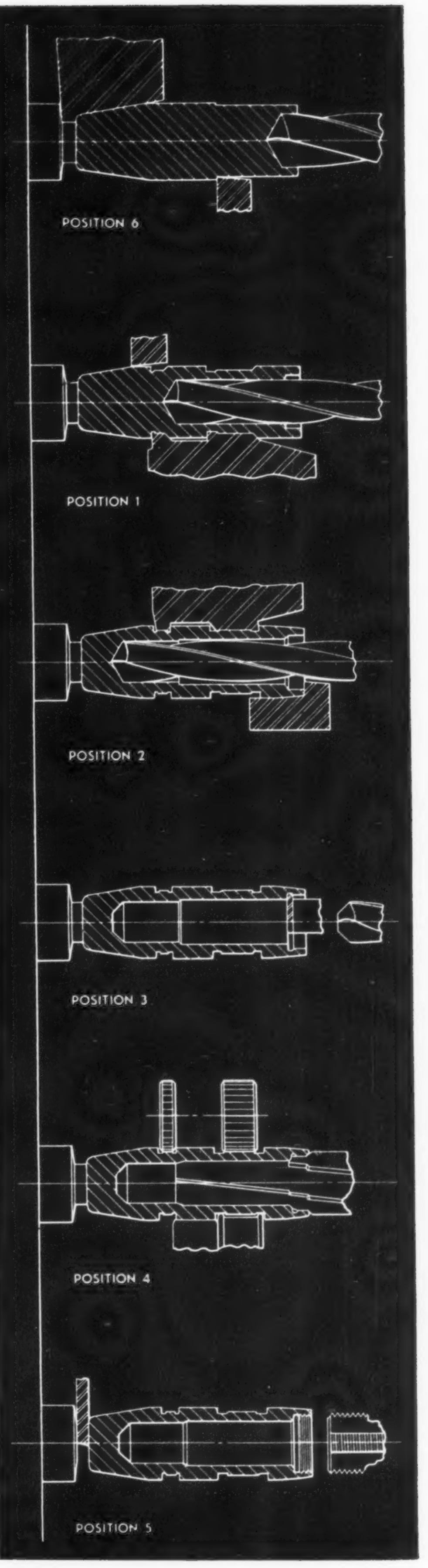


Fig. 9. (Right) Tooling Arrangement for Making a 25-millimeter High-explosive Steel Shell on a Six-spindle Machine

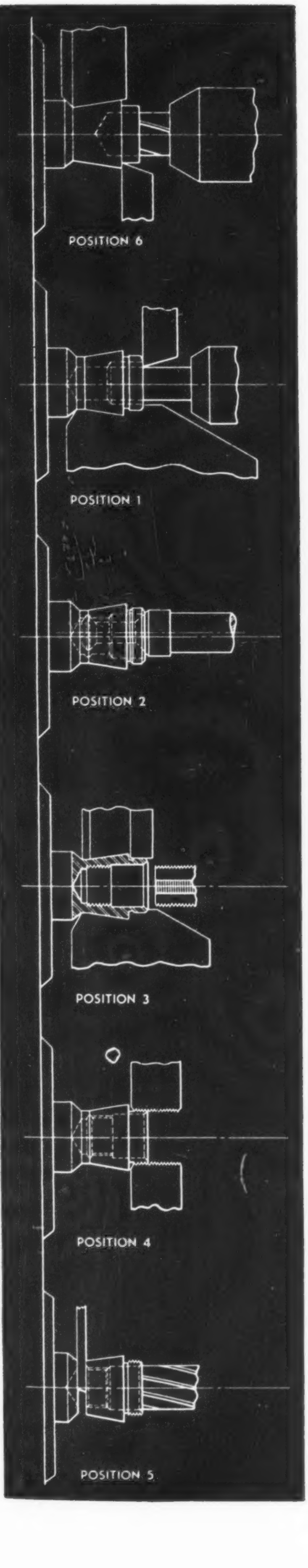


Fig. 10. (Left) Tooling for Making a 25-millimeter Projectile Nose on a Six-spindle Machine

Fourth position: Knurl the bands in each of the two grooves, using roller supports opposite the knurls; form-ream hole as indicated.

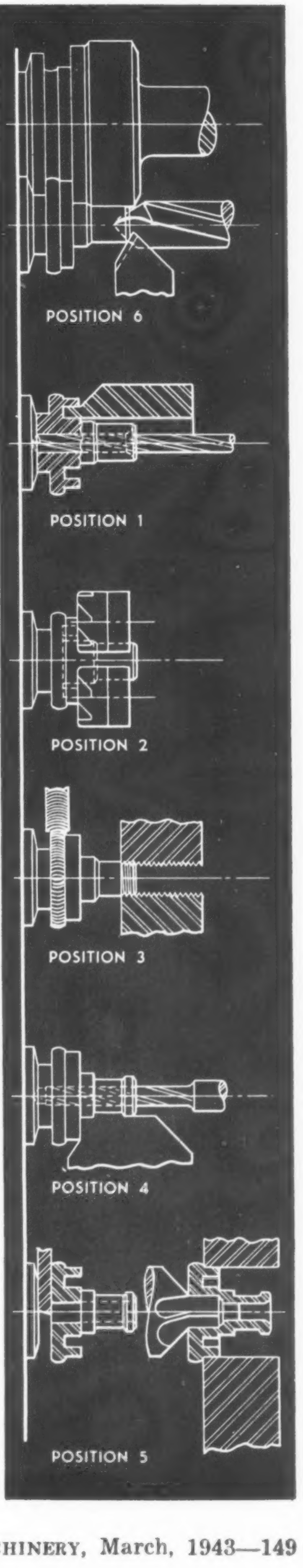
Fifth position: Tap the large hole, using a releasing tap-holder; cut off.

For these operations, the spindle speed is 326 R.P.M. and the production about 54 pieces per hour.

At *H*, in Fig. 1, is shown a 25-millimeter steel projectile nose, which is made on a six-spindle machine with the tooling arrangement shown in Fig. 10. Briefly, the operations are as follows: In the sixth position, rough-form the cone with a circular forming tool; turn the outside end to be threaded; and drill the large hole. In the first position, finish-form the entire outside, using a dovetail forming tool; drill the smaller hole to be tapped; and face the outside end. In the second position, recess at the bottom of the hole to be tapped, using a recessing fixture, and chamfer the end of the large hole. In the third position, tap the hole, using a releasing tap-holder and universal threading attachment, and use a shaving tool and roller support for shaving the outside. In the fourth position, thread the outside, using a universal threading attachment. In the fifth position, ream the large hole, using a floating reamer-holder, and cut off. These operations are performed with a spindle speed of 386 R.P.M. The production is approximately 150 parts per hour per machine.

At *I*, in Fig. 1, is shown what is known as a "knob windage" for a rear sight. This part is made from 13/16-inch diameter steel bar stock on a six-spindle machine. (See Fig. 11.) In the sixth posi-

Fig. 11. (Right) Making a Steel Knob for a Sight on a Six-spindle Machine



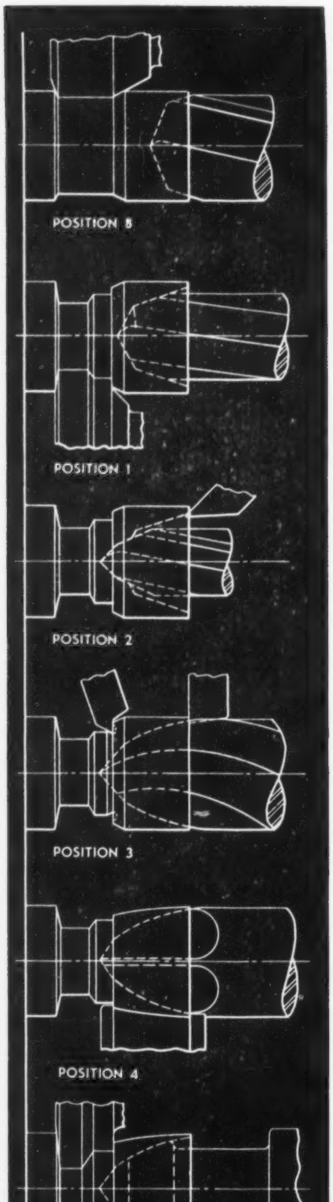


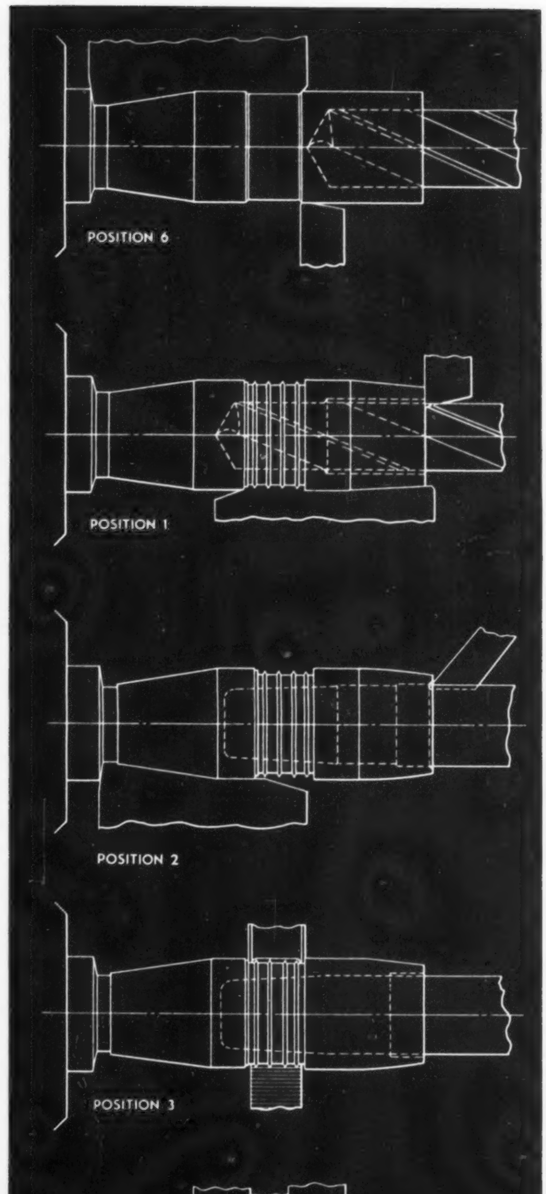
Fig. 12. (Left) Tooling for Making the Nose of a 37-millimeter Armor-piercing Shell on an Eight-spindle Machine

tion, the outside is formed with a circular forming tool, and the end is spotted and chamfered. In the first position, a trepanning operation is performed, as shown, and the hole is drilled. In the second position, the slots are machined, using a rotating milling attachment. In the third position, the outside is knurled and the end of the knob threaded, using a self-opening die-head and universal threading attachment. In the fourth position, the front end is shaved to exact diameter and chamfered, and the hole reamed. In the fifth position, the piece is cut off and picked up by a rotating pick-up attachment with independently operating swinging arm, making it possible to counterbore the rear end. The spindle speed used is 495 R.P.M., and the production 144 per hour per machine.

Making Bullet Noses on Eight-Spindle Automatics

At *J* in Fig. 1 is shown the bullet nose used with the 37-

Fig. 13. (Right) Tooling for the First Operation on 37-millimeter High-explosive Steel Shells Made on a Six-spindle Machine



millimeter armor-piercing bullet body shown at *L*. This bullet nose is made from a steel bar, approximately 1 1/2 inches in diameter, on an eight-spindle automatic. The operations, as shown in Fig. 12, are as follows:

Eighth position: Rough-form back end, using a circular forming tool, and drill end, using a specially ground and formed drill.

First position: Semi-finish the rear end, using a circular forming tool, and drill hole, using a drill ground to a special form.

Second position: Break corner of drilled hole, using an angular knee-turner, and drill the remainder of the hole, using a drill ground to a special form.

Third position: Face the front end, using a knee-turner; rough-profile hole, using a drill ground with a special form; and under-cut as shown, using an under-cutting fixture and tool.

Fourth position: Finish-form the outside contour, using a circular forming tool, and finish-form the hole, using a form-relieved counter-bore.

Fifth position: Finish-form shoulder at rear end and begin forming of point, using a circular forming tool; meanwhile, part is supported in the previously formed hole.

Sixth position: Continue forming of point as far as possible without cutting off, using the same support in the hole as in the fifth position.

Seventh position: Pick up and cut off part, using a circular cutting-off and

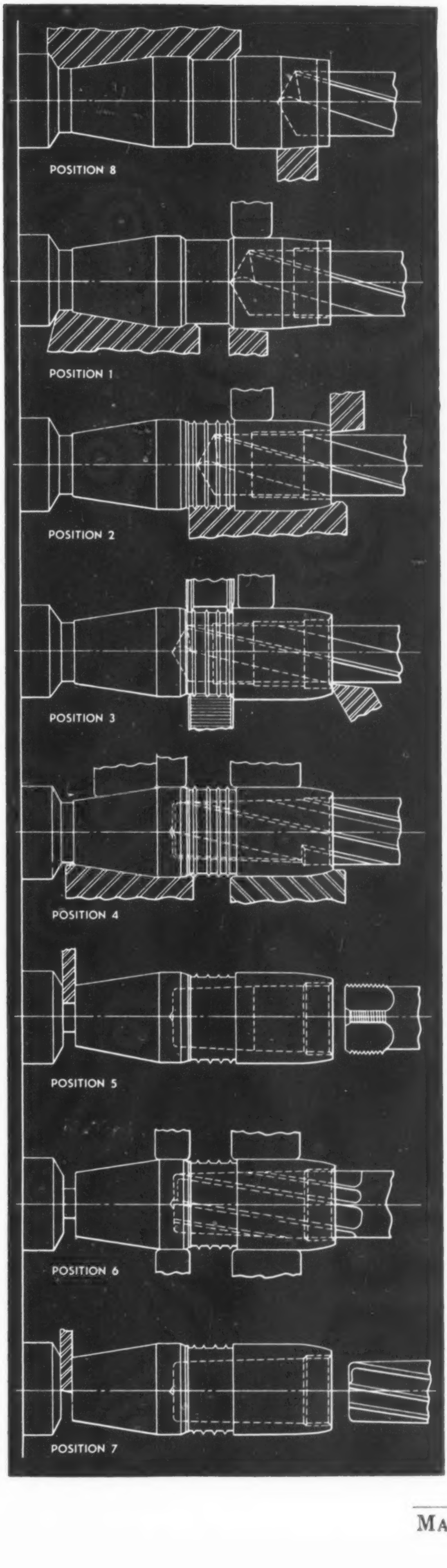


Fig. 14. Tooling Arrangement for Making a 37-millimeter High-explosive Steel Shell on an Eight-spindle Machine

forming tool and pick-up attachment. The spindle speed used for these operations is 163 R.P.M., and the production approximately 60 per hour.

Making a 37-Millimeter High-Explosive Shell

At *K* in Fig. 1 is shown a 37-millimeter high-explosive shell body. Fig. 13 shows how this shell can be made on a six-spindle automatic, and Fig. 14 how the operations are performed on an eight-spindle automatic. Fig. 15 shows a second operation performed on this shell.

Referring to Fig. 13, the operations as performed on a six-spindle machine are as follows:

Sixth position: Rough-form part of the outside, using a dovetail forming tool; turn the outside end, using a knee-turner; and drill hole in end.

First position: Finish-form front end with a dovetail forming tool; face front end; and drill smaller hole, using an oil-hole drill.

Second position: Finish-form rear end, using a dovetail forming tool; counterbore end of hole and chamfer; square bottom of hole.

Third position: Score band seat, using a knurl and roller support; rough-ream hole.

Fourth position: Shave entire outside, using roller supports; finish-

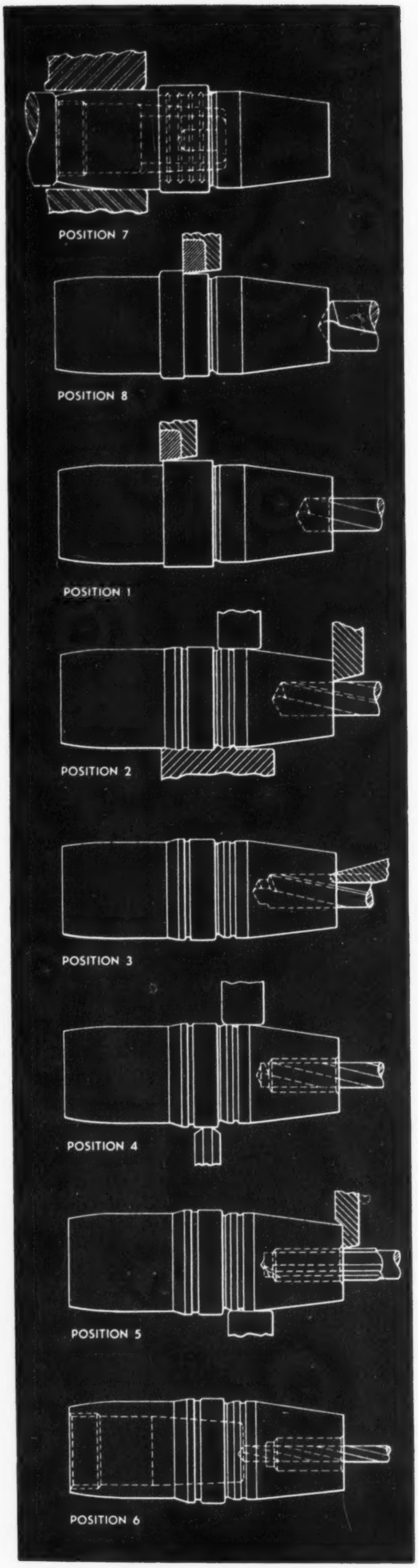


Fig. 15. Second Operation on 37-millimeter High-explosive Steel Shells Performed on an Eight-spindle Machine

ream hole, using a floating holder.

Fifth position: Tap hole in end, using a releasing tap-holder and roller support; and cut off. For these operations, the spindle speed used is 287 R.P.M., and the production approximately 72 per hour.

When performed in an eight-spindle machine, as shown in Fig. 14, the operations are as follows:

Eighth position: Rough-form rear end and band seat with a circular forming tool; rough-turn nose end; and drill hole.

First position: Finish-form rear end with a dovetail forming tool; turn straight portion of front end; and drill hole.

Second position: Finish-form band seat and nose end, using a dovetail forming tool and roller support; face end; and drill smaller hole part way.

Third position: Score band seat; chamfer end of hole; drill remainder of hole.

Fourth position: Shave both ends, using roller supports; rough-counterbore hole; and square end of hole.

Fifth position: Tap hole, using releasing tap-holder; cut off part way.

Sixth position: Burnish straight outside surfaces; rough-ream tapered hole.

Seventh position: Finish-ream hole; and cut off. The spindle speed for these operations is 268 R.P.M., and the production 116 pieces per hour.

To finish the other end of this shell, a second operation is necessary, which is performed on an eight-spindle machine, the tooling arrangement for which is shown in Fig. 15. This machine is provided with a magazine attachment, complete with work-loader and operating mechanism. In the seventh position, the shell, which is now banded, is received from the magazine. The operations from this point on are as follows:

Eighth position: Turn band part way, and spot end of shell.

First position: Turn the remainder of the band, and drill the hole part way in the end.

Second position: Form grooves in band and in body of shell, using a dovetail forming tool; drill hole part way; and rough-face front end.

Third position: Step-drill hole, and chamfer front end of hole.

Fourth position: Stencil the band, using a stencil roll holder and roller support, and square bottom of hole.

Fifth position: Ream hole, and finish-face end.

Sixth position: Drill hole for subsequent tapping. The tapping operation is not performed in this set-up, but is left for a later operation. The spindle speed for the second-operation set-up is 288 R.P.M., the production being approximately 156 pieces per hour.

Making a 37-Millimeter Armor-Piercing Bullet Body

The armor-piercing bullet body shown at *L*, Fig. 1, is made on an eight-spindle automatic as indicated in Fig. 16. The operations are as follows:

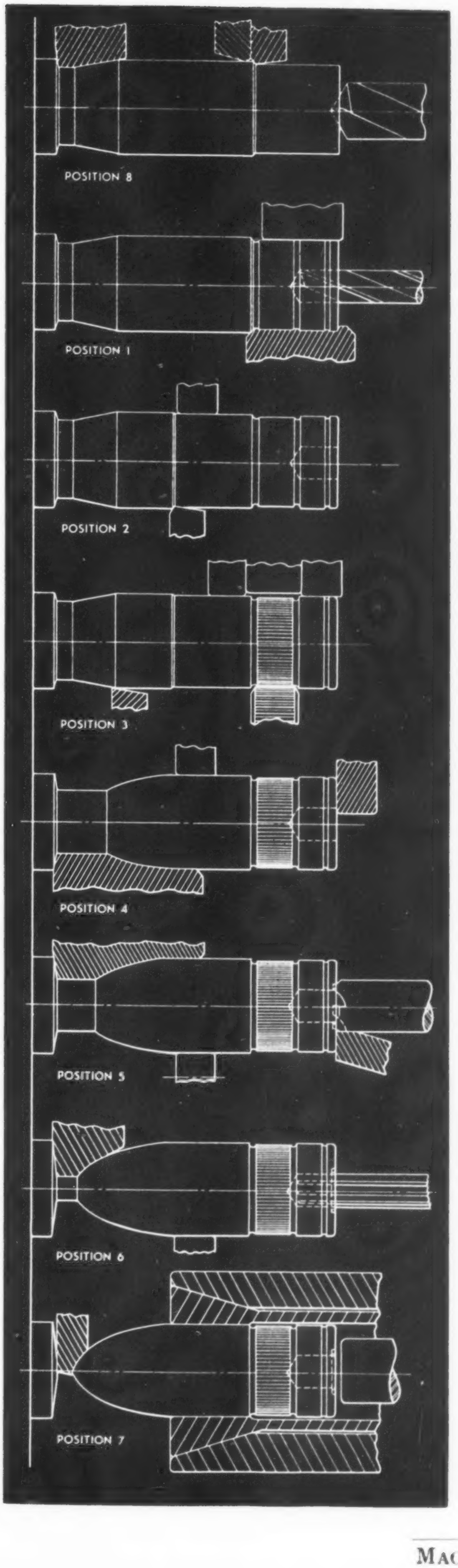


Fig. 16. Tooling for Making 37-millimeter Armor-piercing Shells on an Eight-spindle Machine

Eighth position: Break down at the rear end with a circular forming tool; turn straight diameters; and spot end.

First position: Form band seat and grooves, using circular forming tool and roller support; drill hole in end.

Second position: Turn large diameter, using a roller turner.

Third position: Knurl band seat, and rough-turn nose (rear) end.

Fourth position: Form nose part way, using a circular forming tool; face outer end.

Fifth position: Form nose end part way, using circular forming tool; cut groove in end, using trepanning tool; finish-face outer end.

Sixth position: Form nose part way, using circular forming tool; ream hole.

Seventh position: Pick up and rotate shell while cutting off and forming remainder of nose, using a circular forming tool. The spindle speed for these operations is 163 R.P.M., and the production approximately 30 parts per hour.

* * *

One of the assembly departments at the plant of the Lodge & Shipley Machine Tool Co., Cincinnati, Ohio, is entirely "manned" by women. In this department, small lathes are completely assembled and tested by women.

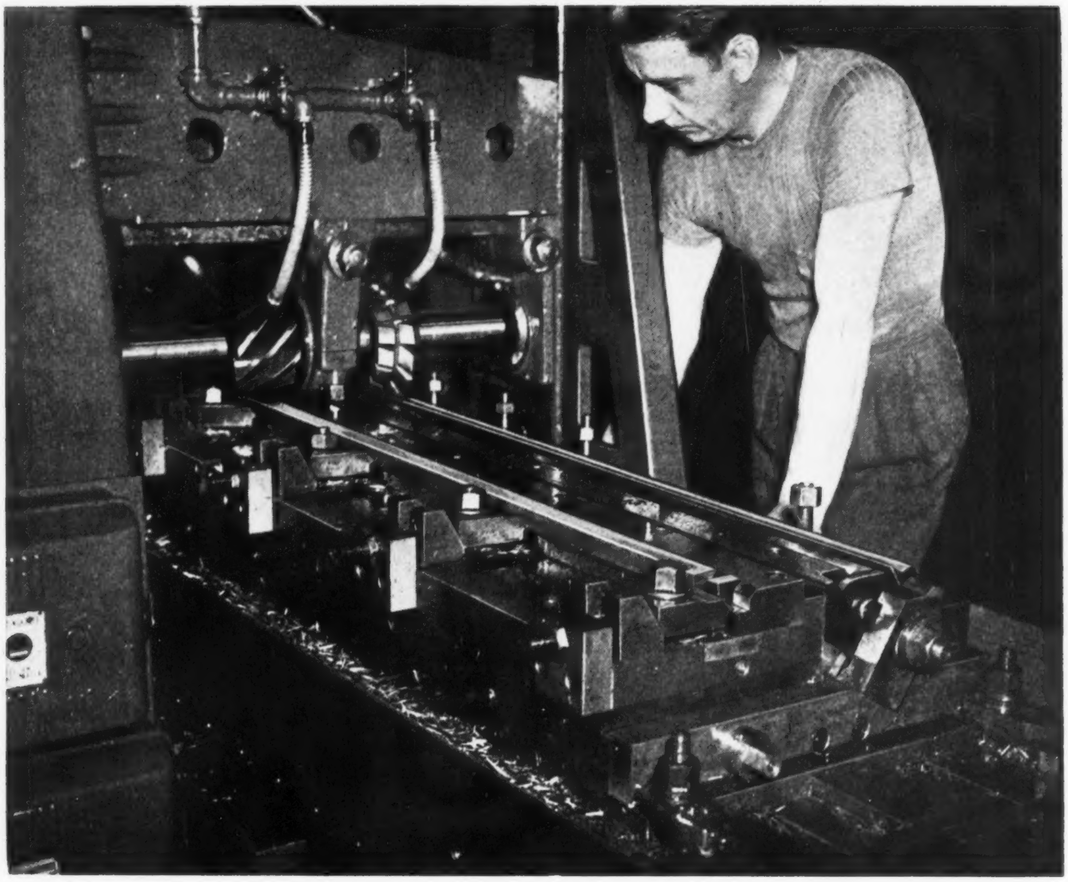
New Developments in Carbide Tool Production

In an address recently made by Adam MacKenzie, vice-president in charge of manufacturing of the Carboloy Company, Inc., Detroit, Mich., an important development known as the "hot press method" was referred to. In this newly developed process, the pressing and sintering operations on carbide tools are carried on simultaneously, thus materially speeding up the processing of large cemented-carbide die nibs, for example, such as are used in large shell dies. In this process, the powder is placed in a closed mold, usually of graphite. The mold and its contents are heated to the sintering temperature while sufficient pressure is imposed in one direction to overcome the forces that cause shrinkage in the other two directions. The molds are usually heated electrically. Pressures of from 400 to 2500 pounds per square inch are commonly used.

Another process recently developed is that of extrusion, by which rods, tubes, and non-symmetrical cross-sections of cemented carbide are formed in lengths not hitherto obtainable.

The transition from laboratory work to production operations has brought about the development of equipment capable of producing cemented carbides in varied shapes and in sizes up to 50-pound pieces.

Milling Operations on Ship Turbine Blades



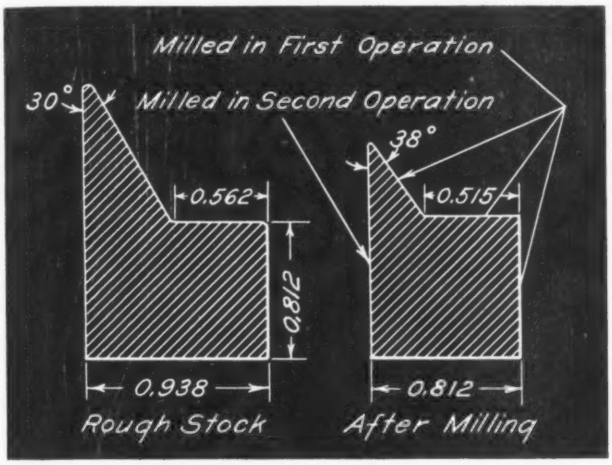
Second of Two Articles on Operations in the New Westinghouse Merchant Marine Turbine and Gear Plant. Interesting Methods Used in Milling the Complex Contours of Turbine Blades

By ELLIS L. SPRAY
Manager of the Merchant Marine Division
Westinghouse Electric & Mfg. Co.

IN the first article on the new Westinghouse merchant marine plant, at which turbines and gears are being built exclusively for merchant ships, methods of fabricating and machining the gear blanks, gear-cases, and cylinder covers were described (see MACHINERY, November, 1942). In this article, some of the important operations on the turbine blades will be discussed.

In the blade shop, one unusual operation is the profile-milling of blade sections on a Fitchburg milling machine, as shown in the heading illustration. The stock is in the form of rolled stainless-steel shapes, 36 to 48 inches long. Because the climb-cut milling principle is employed, it is not necessary to use hold-down clamps on the work-fixture. For the profile-milling of the inlet and concave sides of the stock, the work is loaded into a depression which extends the length of the fixture at the front. A key at the end of the fixture, as seen in the illustration, is swung over into a slot previously

Fig. 11. Cross-section of Rolled Stainless-steel Blade Stock before and after Profile- and Slab-milling Operations



milled on one end of the turbine blade stock to prevent endwise movement during the milling operation. A clamp at the end of the fixture pulls the bar of stock down into its seat in the fixture and against the key.

Interlocking form cutters are used for milling the inlet and concave sides in one operation, as indicated by the right-hand view in Fig. 11, to a profile tolerance of 0.001 inch. After this contour milling on the inlet and concave sides, the work is reloaded in a second position at the rear of the fixture for milling the flat outlet side with a slab cutter, as indicated. On the outlet side, 0.005 inch of stock is allowed for grinding.

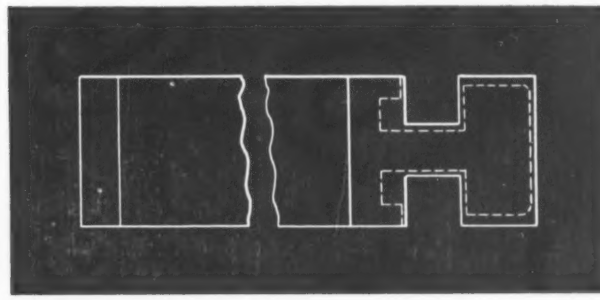


Fig. 13. Seven Surfaces on Each Side of a Blade Base, as well as the Bottom Surface of the Base, are Cut in One Broaching Operation

Once loaded, the machine continues through its work cycle automatically, so that the operator has time to cut the stock that has passed through these two operations to 7 1/8-inch lengths on another machine.

The concave face of the cut blade stock is then finished on another machine, and both sides are ground to within 0.001 inch tolerance. Seven surfaces on each side of the stainless-steel blade base, as well as the end of the base, are broached, as shown by the dotted lines in Fig. 13, on a 20-ton, 90-inch stroke, single-ram Lapointe broaching machine in one operation.

Previous to the adoption of the broaching method of cutting the blade bases, five milling operations were required. It is of interest to note that one dimension of the blade base must be held to a tolerance of plus 0.001 inch, minus 0.000 inch. The other dimensions must be within minus 0.002 inch, plus 0.000 inch.

Fig. 12. Milling Ports on Convex Side of Turbine Blades in Horizontal Milling Machine with Fixed Table. Two Turbine-blade Blanks are Held at Each of Six Stations Located around a Drum Fixture

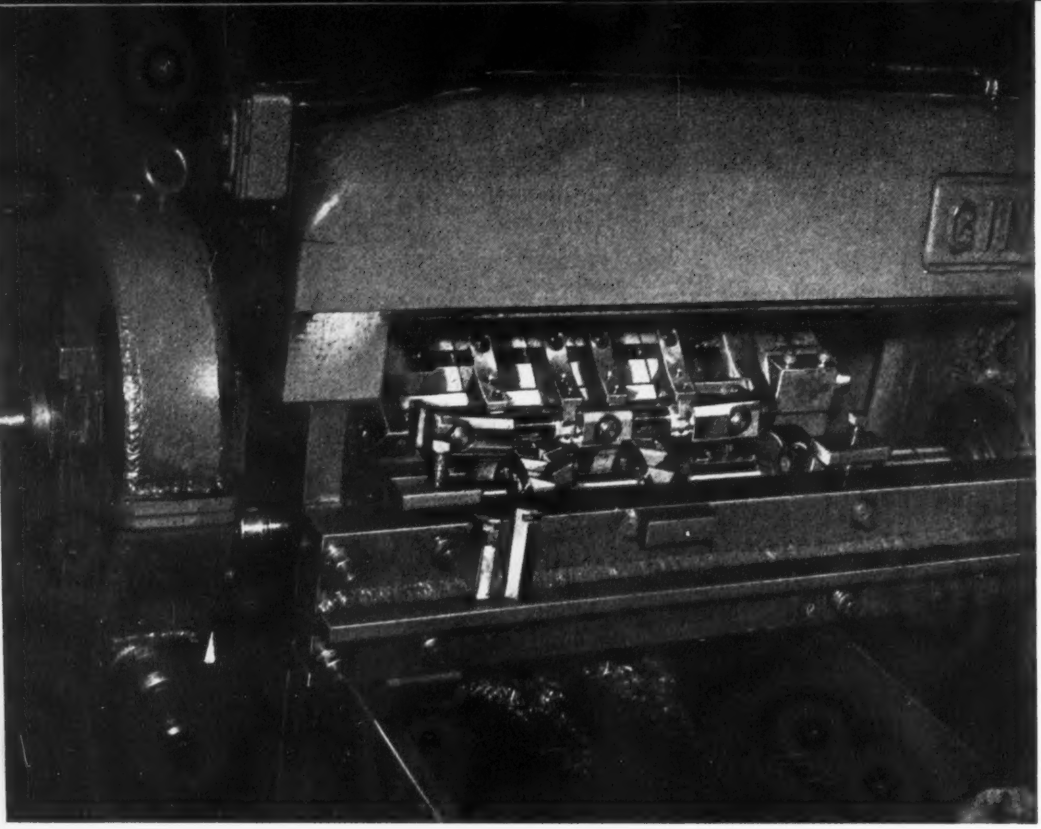


Fig. 14. Rear View of Milling Machine Shown in Fig. 12. Cutters, Rollers and Cam-plate Lobes are Visible. Blade with Finished Contour and Blank before Milling are Seen in the Foreground of Illustration

After locking grooves have been broached in the shank or base ends, the rotating reaction blades and all impulse blades, both stationary and rotating, are sent to a Cincinnati milling machine for milling the ports on the convex side. The turbine blades are mounted on a drum fixture, and their contours are generated as the fixture is revolved past interlocking cutters. The operation is illustrated in Figs. 12 and 14.

The fixture has six stations and holds two work-pieces at each station. There is a star-shaped cam-plate on each end of the drum which is held in contact with a roller on the cutter-arbor by means of air cylinders. Thus, as the fixture revolves, the cams cause the work to be carried back and forth and the cutters generate the proper contour. The rollers and one lobe of each cam-plate are visible in Fig. 14. The valve for controlling the air cylinders mentioned is seen in Fig. 12. A separate motor located at the rear of the machine is used to rotate the drum fixture. The machine table, itself, remains fixed throughout all operations.

In some types of blades, the ends of the ports must be milled at an angle. To accomplish this, there is a second air cylinder at the back of the

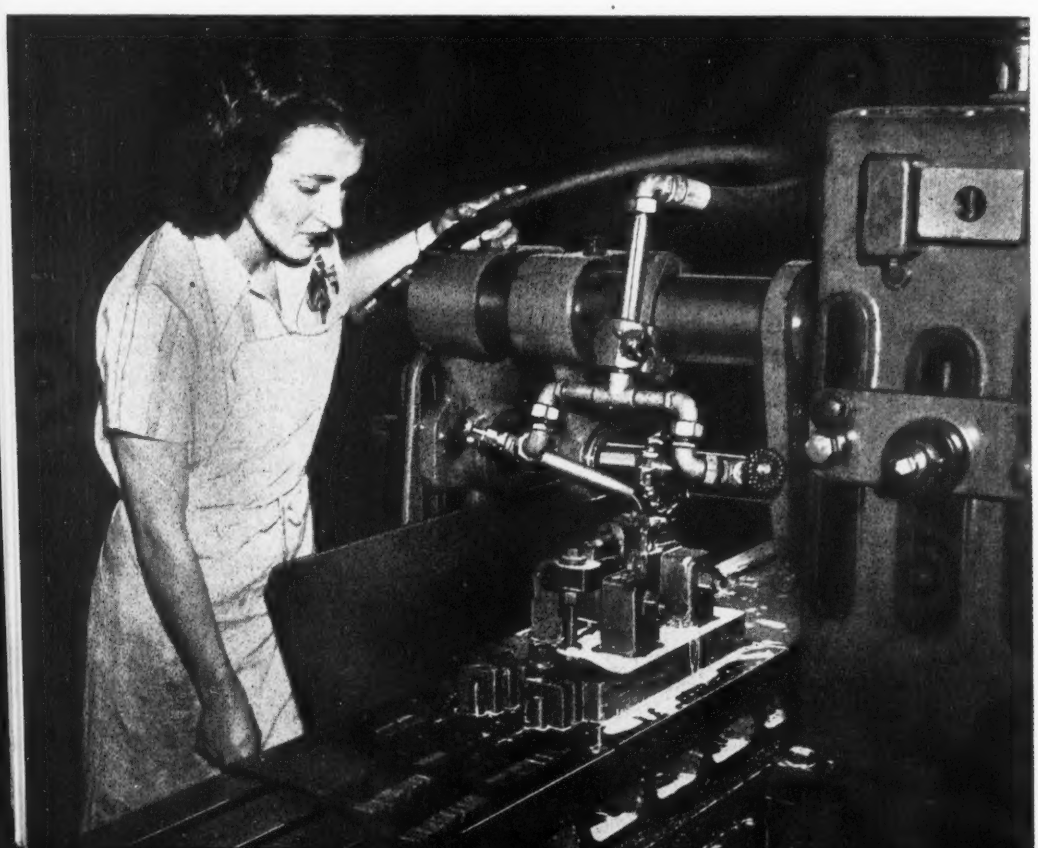


Fig. 15. Milling Convex Form and Taper on Brazed Reaction Cylinder Blade. More and More Women are being Employed in This Turbine Plant for a Variety of Machining Operations

machine which is utilized to give the work-drum an endwise motion, in addition to the backward and forward motion obtained through the star-shaped cam.

The machine operates continually, loading and unloading being accomplished manually by the operator. Five machines of this type, each equipped with a special work-holding fixture designed for a specific size and shape of blade, are used to turn out turbine blades in the large quantities required by the marine production program. In some set-ups, three turbine blades are mounted in each fixture station instead of two as illustrated.

Some idea of the many surfaces to be machined and the curved contours to be generated on each blade may be gained from Fig. 16, which shows sketches of two forms of turbine reaction blades.

Women are already operating many machines in the blade shop, and it is expected that ultimately about one-half of the workers in the blade shop will be women. In Fig. 15, a woman is shown operating a Milwaukee milling machine that mills the convex form and taper on a brazed reaction cylinder blade. Both form and taper must be held to a tolerance of 0.001 inch.

The sides of the large turbine blades are milled on a Fitchburg duplex straddle-milling machine, as shown in Fig. 17. This blade is forged entirely of stainless steel, and is the largest forged cylinder blade made in the plant. As shown in this illustration, the blade is actually clamped in the fixture against its curved contour, being seated on blocks that fit the concave side of the blade section, while upper clamps fit down over the convex side. End-mills, 3 1/2 inches in diameter, are used in this operation. The tolerance on the width of the base is plus or minus 0.0015 inch. One blade is always left in the work-fixture when a job is completed for locating the first blade of a succeeding job.

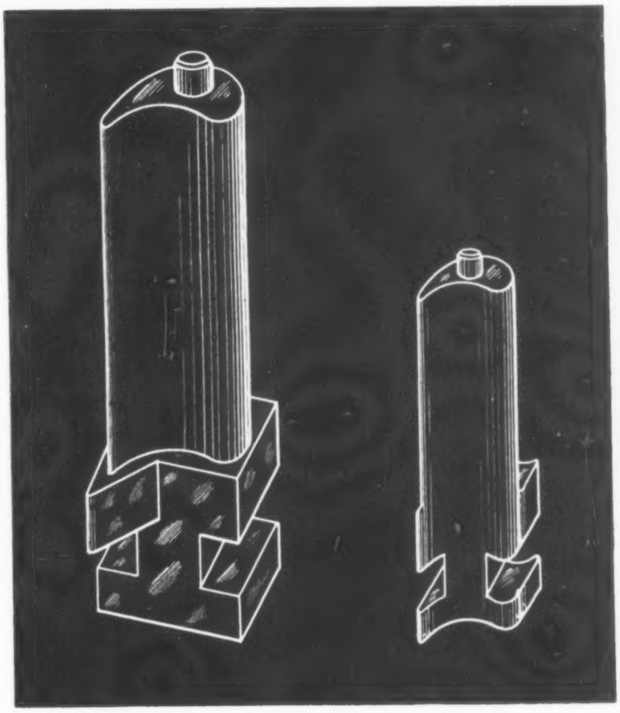


Fig. 16. Two Reaction Blades of Somewhat Different Form, Showing the Number of Surfaces and Difficult Contours which must be Accurately Cut in the Successive Machining Operations

Fig. 17. Straddle-milling Sides of Large Turbine Blades. Machining is Held to Close Limits, in Spite of the Fact that Blade is Located by a Curved Surface in the Fixture

Engineering News Flashes

Impact Switch Prevents Accidental Aircraft Fires

Included in the long list of safety devices developed for aircraft is an ingenious "impact switch" which automatically discharges several pounds of liquid carbon dioxide into the engine compartment if a plane crashes. The device, developed by engineers of Walter Kidde & Co., functions as an automatic fireman to release clouds of fire-killing vapor, even though the pilot may be unconscious. The switch contains a trigger device which is set to act in the case of a crash.

Air-Conditioning Equipment Used in Testing 37-Millimeter Shot

Equipment has been developed by the Conditioned Air Equipment Co. for a midwestern ordnance plant for the shock-testing of 37-millimeter shot before inspection by Ordnance Department inspectors. The shot is armor-piercing, and if there are any strains, stresses, or defects in it, the shock test cracks them open and the shot is rejected. The testing equipment occupies a floor space of 26 by 26 feet, and requires only the part-time services of one girl to load and unload.

The unit consists essentially of a conveyor system leading in and out of a series of insulated tanks containing water having a temperature of 40 degrees F. and 212 degrees F. The shot is brought from room temperature to 40 degrees F. (specifications call for cooling below 60 degrees F.), in one water bath, is then plunged into a second bath of water having a temperature of 212 degrees F., and finally brought down again to 40 degrees F. in a third water bath. From here it goes through a soluble oil bath to prevent corrosion.

Refrigeration for the unit is provided by a 5-H.P. General Electric condensing unit connected to an Acme cooler. The condensing unit, water-cooling unit, and a circulating pump are mounted below the tanks. A standard General Electric gas-fired boiler supplies heat for the 212-degree tank. The foregoing is an example of how peacetime engineering experience is being used to aid the nation's war effort.

Tension on Belts Greatly Influences Belt Life

The B. F. Goodrich Co., Akron, Ohio, has made some valuable tests on transmission belting and V-belts to show the influence of slightly increased belt tensions. Belts 6 inches wide and 30 feet long, spliced in 10-foot lengths, were used. One of these belts ran for 95 hours before breakdown under a total tension of 864 pounds. When the tension was reduced to 720 pounds, the life was increased to 230 hours. Another belt under similar conditions had its life increased from 88 to 263 hours, and still another, from 15 to 48 hours. It should be noted that the decreased life of the belting was caused by only a 20 per cent increase in the belt tension.

A Load of 1000 Tons will be Carried on This 8-foot Thrust Bearing at the Upper End of the Large Shaft of a Westinghouse Water-wheel Generator for Grand Coulee Dam. Suspended from This Thrust Bearing is the 530-ton Rotor of the Generator; a 200-ton Shaft Assembly; and a Water-wheel of 150,000-H.P. Capacity which Drives the Generator. All This Weight and the Downward Thrust of Water Pouring through the Turbine at a Rate of 141 Tons a Second, is Supported by the Eight Thrust Blocks Resting on the Top of the Generator Frame

More Production per Man-Hour

IN an article published in *Pulling Together*, DeWitt Emery, president of the National Small Business Men's Association, which has executive offices at 1635 Pittsfield Bldg., Chicago, Ill., emphasizes the need for more production per man-hour of work. Mr. Emery refers to the statement by Donald Nelson that the nation's output of all war materials last August was 14 per cent short of the mark.

Commenting on this, Mr. Emery says: "The answer is more production per man-hour of work. Remove the restrictions and limitations placed on production by labor unions, thereby permitting the men and women in our factories to do their best, to turn out all they are capable of turning out, and production will shoot up. My guess is that the increase would be far more than 14 per cent—perhaps 25 per cent.

"What kind of restrictions am I talking about? Here is a typical example, and if anyone wants more examples, we have plenty of them.

"In an Ohio town there is a machinist, past sixty, who for the last twenty years has operated his own small machine shop. After the defense program got under way, his troubles in getting material and keeping his help started to pile up, and finally reached the point where he decided he would be better off to close his shop and get a job in a larger shop.

"He had not worked at a machine for many years, and was, therefore, a little rusty. Because of this, he didn't feel that he would be able to turn out enough work to justify full-scale pay, and was willing to start at a lower rate. He discussed this with the employer and was put on the payroll at 20 cents an hour under the regular hourly rate. The second day he was on the job one of the business agents of the union asked him what his rate was. He told him 20 cents an hour less than the scale, because he was not able to turn out enough work to justify full-scale pay. The agent said, 'What the hell's that got to do with it? I'll see that they pay you the full rate.' And he did.

"The fourth day he was on the job he was turning some parts on a lathe, each of which had to be touched up on the bench after being taken off the lathe. He would machine a part, take it off the lathe and lay it on the bench, and then start the lathe on the next part; while it was running, he would file the preceding part at the bench, at the same time keeping an eye on the lathe to be sure it was working all right.

"No one told him to do this. It was just second nature for him to organize his work so as to be doing something all the time. That's the way he had worked all his life and that's the way the men in his shop had worked. His idea was to give full value for what he was paid.

"Therefore, he didn't pay any attention when several of his fellow-workers told him that he didn't have to 'kill himself' in order to hold his job. According to his way of thinking, the question of 'killing himself' was not involved at all. He was simply working along at a nice comfortable pace which he could keep up all day; so he kept right on running the lathe and working at the bench at the same time.

"The next day the business agent, who incidentally was about half his age and probably has draft deferment because of his great value to the war effort, came to him and said, 'Look, Pop, you are doing too much work. The other boys will have to work too hard to keep up with you. So from now on, you cut out doing two things at once. When you run the lathe, don't work on the bench. When you work on the bench, don't run the lathe.'

"On his way home that afternoon, 'Pop' stopped in a drug store and telephoned his employer to tell him what had happened and to ask what he should do. His employer said, 'You'll have to do what they say. They are in the driver's seat. I know exactly how you feel, but my hands are tied. There isn't anything I can do.'

"The loss in production is staggering and no one can tell what the unnecessary sacrifice of life may be. Also, paying full wages for 50 to 75 per cent efficiency materially increases the cost of the war.

"I might give other examples, such as the balloon room in a rubber plant being tied up for several hours because one of the girls was 80 cents behind on her dues and the union wouldn't let anyone work in that department until she had paid up. Several hundred hours of production were lost. Or, construction on a $50,000,000 steel plant being tied up for two months because of a dispute between two unions as to which union would unload pipe."

What is the answer? Mr. Emery suggests that for the good of the country, for the success of our war effort, for the survival of business, and for lasting benefit to labor and labor organizations themselves, practices of this kind should be stopped. But how can they be stopped? Perhaps the unions themselves will give a hand. There still are real leaders in the unions, men who have become leaders because of their true interest in the welfare of labor. These leaders, if supported by the membership of the unions, could regain control and authority, and displace the selfish type of leadership that recently has caused so much severe criticism.

EDITORIAL COMMENT

Industry Needs a Courageous Post-War Platform

Business and industry need a platform expressing their post-war policies. The New Deal has a fairly well defined program; Labor has made its objectives quite clear; business and industry, however, as a group, have not formulated a definite platform that would give a clear picture of the conditions that will make it possible for industry to operate effectively in the future, as in the past.

Such a platform should state positive requirements rather than negative objections. It should emphasize the necessity for free enterprise and individual initiative. It should clearly define where the man who creates employment and provides jobs stands in relation to those who, without such initiative, find it necessary to be idle unless somebody offers them a job. Both groups are necessary to a prosperous nation and to the maintenance of a standard of living commensurate with the production capacity of our country; but each group must have its rights, as well as its responsibilities, clearly defined.

Some of the maladjustments and erroneous doctrines of the past decade must be corrected, and a sense of fairness to all concerned must be adopted. Primarily, the man who, through his initiative, creates jobs and provides employment must regain his right to determine whom he shall employ to do his work.

Does Industry Want a Compulsory Form of Government?

Another point that the platform should make clear is that Government, after the war, should return as soon as possible to its proper province of authority and jurisdiction, and should cease meddling with things that can be settled best by individuals between themselves, acting as free and independent men and women.

In the last ten years, we have drifted swiftly toward socialism in our governmental conceptions, even though we may not have given that name to our goal. Since it is quite certain that the majority of the American people do not believe that a compulsory socialistic form of government is desirable for a free people, clear-cut policies should be expressed by business and industry, advocating the abandonment of some of these socialistic doctrines and a return to the free, voluntary type of business enterprise under which this nation became prosperous and strong.

Some of the prominent business and industrial organizations should formulate a clear-cut platform—without pussyfooting—and should then endeavor to have this platform endorsed by industrial and trade organizations throughout the nation, so that when peace once again returns, business and industry may have a clear-cut program of their own, stated as definitely as that of other groups within the community.

This program of business and industry should be liberal and broadminded, and its chief criterion should be that it is fair to all concerned and favors no segregated group or interest.

We Should Begin to Recognize what This War Means

The American people generally do not yet realize what a serious fight they have on their hands. They are still too sure of victory, and do not realize that, without sacrifices, victory is by no means assured. Our plan is to fight this war abroad because it is more desirable to fight there than to have the enemy force us to fight on our own soil.

There is a tendency among all nations, including our own, to magnify victories and to minimize defeats. While there is every reason why we should have confidence in the final outcome, we should recognize that victory is to be achieved only when the American people realize that the winning of the war is the one important factor in every individual's life. The English did not realize what this war meant until after Dunkirk. We must wake up to the fact that we are engaged in a life and death struggle with very powerful enemies.

Building Flying Fortresses

By CHARLES O. HERB

FLYING Fortresses with much heavier armament than in the past are being turned out in large numbers to carry the war directly to enemy lands. Some of the methods employed in making these huge bombers at one of the plants of the Boeing Aircraft Co. were described in an article published in July, 1942, MACHINERY. Additional operations will be shown in this article.

Fig. 1 shows a flap control screw about 44 inches long over all having its thread ground in an Ex-Cell-O thread grinding machine within a lead tolerance of 0.0005 inch per inch of length. A tolerance of 0.002 inch is allowed on the diameters. The thread is of single Acme type, 2 inches in diameter, four threads per inch. It is first rough-cut in a lathe to a root diameter of 1.2775 inches, and then ground to 1.730 inches within the tolerance necessary. It is made of bar stock of X 4130 S A E specification.

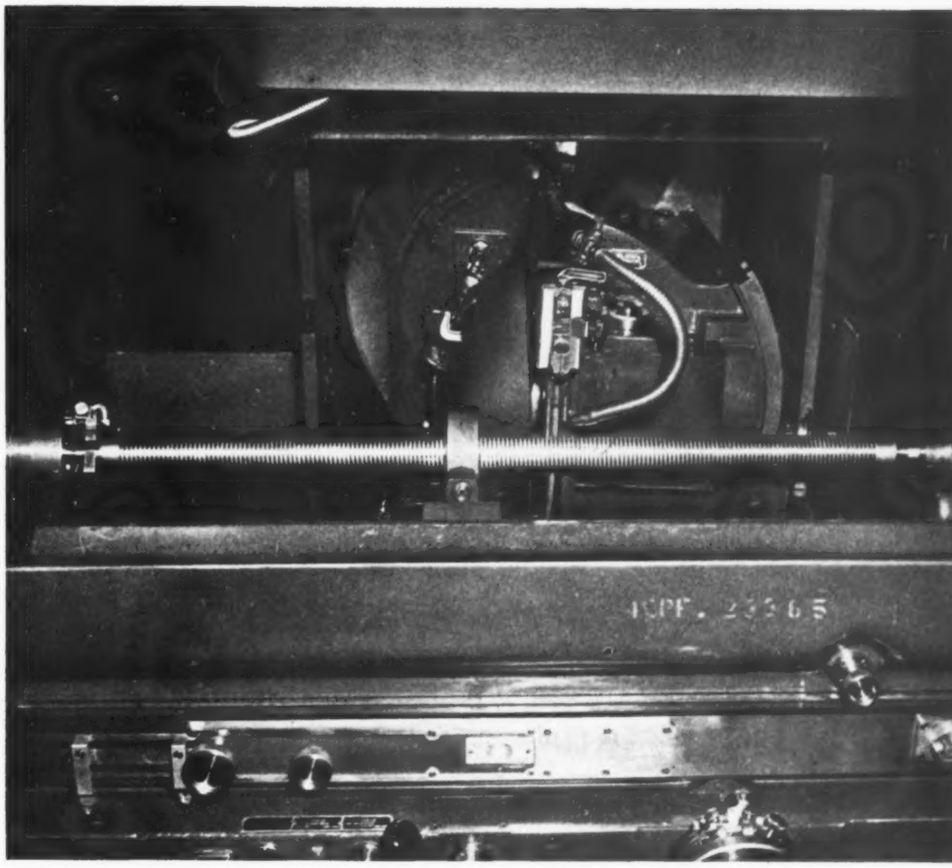


Fig. 1. Grinding the Thread of a Flap Control Screw to a Lead Accuracy of 0.0005 Inch per Inch of Length

A Heald "Bore-Matic," set up for rough- and finish-boring rudder hinge fittings cast of aluminum alloy, is shown in Fig. 2. One spindle of this machine is equipped with four rough-boring cutters and a facing cutter. The boring cutters are set to different diameters so as to distribute the amount of stock removed by each. The finishing spindle is provided with a fly cutter that extends across the face of the spindle so that it can cut on both ends. All the cutters are tungsten-carbide tipped.

Fig. 2. Rough- and Finish-Boring Operation Performed on Rudder Hinge Fittings on a Mass Production Basis

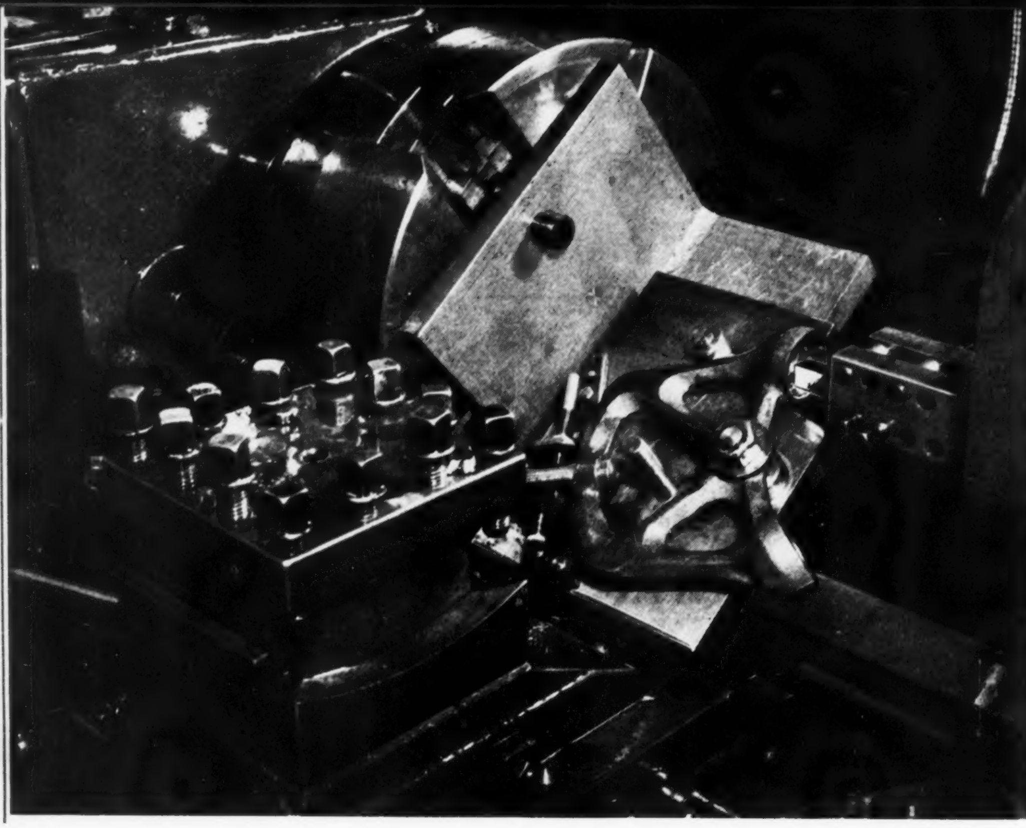


Fig. 3. Unusual Work Set-up Adopted for a Turret Lathe to Enable Cups to be Machined at an Angle in Quadrant Castings

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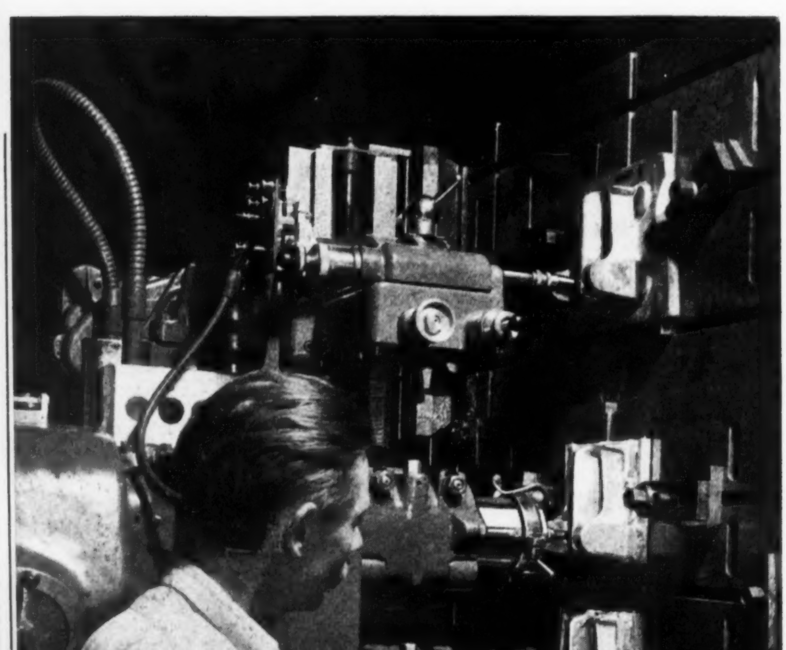
Fig. 4. Producing Three Odd-shaped Pieces at One Time on a Kellermatic has Expedited the Production of Certain Types of Work



In rough-boring, stock is removed to a depth of 1/2 inch on a side at the point of heaviest cut. From 0.015 to 0.026 inch on a side is removed in finish-boring. When finished, the bore must be 3.510 inches in diameter within plus 0.005 inch, minus nothing.

Accurate boring of quadrant castings to two angles is performed on the Warner & Swasey turret lathe shown in Fig. 3. Cup-shaped openings in two arms of these quadrants must be machined at an angle in relation to the center line through the casting. To position the work accurately for boring either cup, a previously finished hole in the casting is seated over a hardened and ground plug on a fixture that is mounted on an angle-plate attached to the lathe chuck. A locating pin inserted through another hole at the opposite end of the work is positioned between two adjusting screws to hold the part at the required angle. For machining the opposite cup, the part is merely turned over on its other side and similarly positioned on the fixture. A forming tool ground to a double radius to provide the required shape in the cups is mounted on the turret of the machine.

Kellermatic machines are used extensively for milling parts of odd shape, particularly parts for planes that are still in the experimental stages, and for which castings or forgings of the approximate shapes are not yet available. Fig. 4 shows a typical operation in which three pieces of aluminum alloy are being milled at one time to the shape of a plaster model.

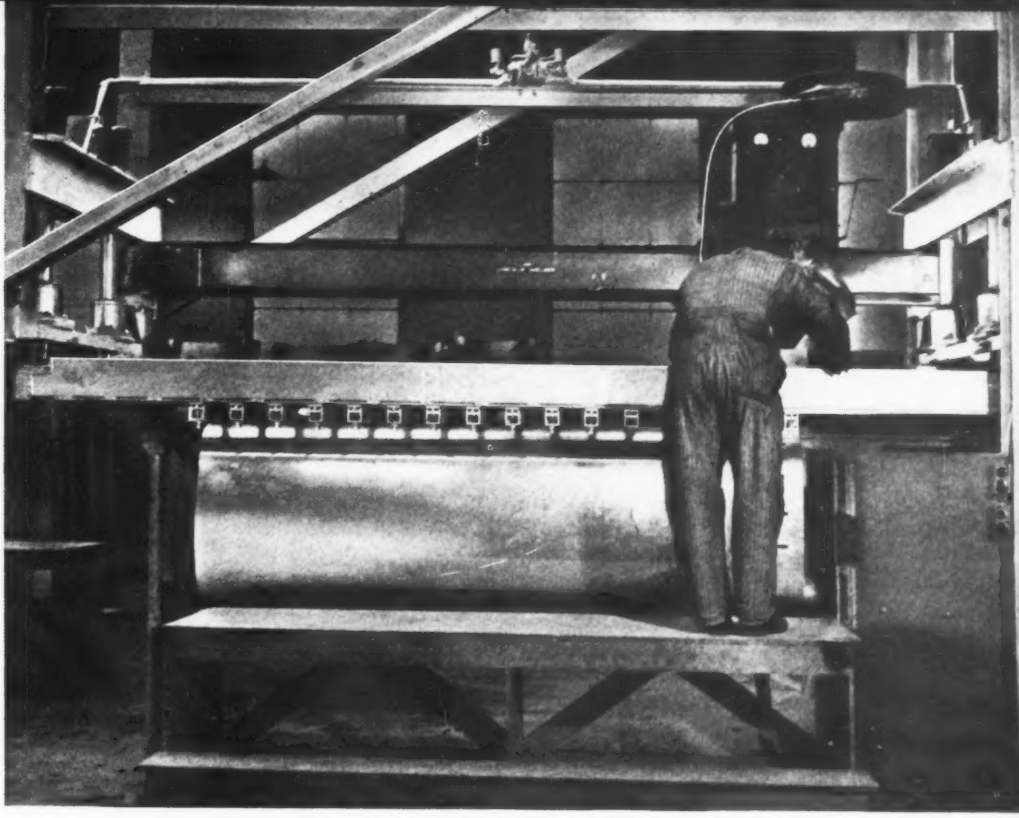


Fig. 5. Automatic Arc-welding Machine Built for Welding together the Two Aluminum Sheets that Make up the Bodies of Gasoline Tanks

An electrical tracer follows the outline of the model, which is mounted at the top of the vertical table.

A Lincoln arc-welding machine of automatic design, used in welding together two sheets of aluminum alloy to form the body of gasoline tanks, is illustrated in Figs. 5 and 6. From Fig. 6 it will be seen that the two sheets are supported from beneath by means of a special fixture and on top by a series of bars which are clamped firmly on the work by overhead air cylinders. The welding head travels across two large channel irons. Electrode wire is fed from the coil seen at the upper right in Fig. 5. The 300-ampere electric welding unit is equipped with a special exciter. The aluminum-alloy sheets from which these tanks are constructed are 1/8 inch thick.

* * *

Simplified Practice Recommendation for Wire Rope

A Simplified Practice Recommendation for Wire Rope became effective on February 15. Information concerning this recommendation can be obtained from the Division of Simplified Practice, National Bureau of Standards, Washington, D. C. It is identified as "R198-43" and lists sizes, constructions, grades, and breaking strengths of wire rope. This recommendation has been developed by engineers in the wire rope industry, to serve as a wartime conservation measure.

Fig. 6. End View of Automatic Arc-welding Machine Seen in Fig. 5, which Shows Method of Supporting Sheets and of Clamping Them on Top

How to Get in the Scrap

EVERY reader of MACHINERY knows that scrap is an indispensable raw material, especially at the present time, but the importance of systematic scrap salvage is not always fully recognized. This article outlines briefly the essential features of a plan for rounding up scrap regularly, so that it never remains idle and useless, but is always moving steadily toward the war production line. This plan has been developed under the direction of R. Merrill Decker, New York regional chief of the Industrial Salvage Section, War Production Board.

Some idea of the magnitude of this scrap-collecting organization is indicated by the fact that in Greater New York alone about 26,000 firms of all kinds are cooperating. The various industries with which these firms are connected are divided into general groups representing broad classifications by more or less related industries. The "Machinery, Instruments, and Electrical Equipment" group is one of the most important scrap producers, although it includes, in the Greater New York area, only 753 firms, or less than 3 per cent of the total. During the last six months of 1942, the 26,000 firms mentioned supplied over 314,000,000 pounds of scrap. Of this, over 30,000,000 pounds, or about 10 per cent, was obtained from the Machinery, Instruments, and Electrical Equipment group.

The organization for collecting this scrap regularly and systematically, and stimulting interest in this important salvaging job, has been reduced to a very simple form. Each industrial salvage committee throughout the United States consists of a committee chairman and a number of assisting committeemen. For example, Morehead Patterson, president of the American Machine & Foundry Co., is chairman of the Industrial Salvage Committee for Machinery, Instruments, and Electrical Equipment in the Greater New York area. The committee under Mr. Patterson consists of sixteen men. These are all either presidents of their respective companies or other prominent executives.

Each of these committeemen becomes what might be described as a scrap-recruiting sergeant. He visits an assigned group of industrial plants for the purpose of getting full cooperation in making scrap salvage a regular part of the plant's activity. To insure results, a "Salvage Executive" is appointed in each plant. Frequently, this executive is president of the company. An important part of his job is to know scrap, even when it is part of equipment that is obsolete.

Special forms or cards are used by each company in reporting scrap collections to the regional office. A sample of these, as reproduced here, clearly indicates their simplicity. Typical figures have been inserted to indicate the character of the information given by a plant in the Machinery, Instruments, and Electrical Equipment group. The left-hand section is a return postcard, and the right-hand part is retained as a company record.

This plan is simple, direct, and effective, and that is why it has been adopted nationally. It brings in the scrap without waste of time or red-tape entanglement, and it keeps the scrap stream flowing steadily out into the furnaces and mills where the first steps are taken in forging the numerous implements that Uncle Sam needs for the big job ahead.

Too much emphasis cannot be placed on the importance of scrap salvage. The steel industry cannot operate without steel scrap, nor can the war be fought without steel.

MAIL BY 20th OF MONTH

(Company reporting)

(Address)

(Salvage manager or person reporting)

DATE		KEY	16—27830-1	
Iron and Steel			6500	lb.
Nonferrous Copper, Brass, Aluminum, etc.		A	1000	lb.
		B	1650	lb.
				lb.
Rubber			254	lb.
Other Paper, Rags, etc.		C	1230	lb.
				lb.

Sold To—
A Aluminum
B Copper
C Miscellaneous

RETAIN FOR YOUR RECORD

(Company reporting)

(Address)

(Salvage manager or person reporting)

DATE		KEY	16—27830-2	
Iron and Steel				lb.
Nonferrous Copper, Brass, Aluminum, etc.				lb.
				lb.
				lb.
Rubber				lb.
Other Paper, Rags, etc.				lb.
				lb.

Sold To—
A
B
C

Card Used by Companies in Reporting Scrap

Exhibition and Meeting of Tool Engineers

THE 1943 Machine and Tool Progress Exhibition, sponsored by the American Society of Tool Engineers, to be held in conjunction with the Society's annual meeting in Milwaukee, March 25 to 27, promises to be an interesting and useful event. The exhibition will be somewhat smaller than previous shows sponsored by the Society, since it is not planned to encourage exhibits that do not bear directly on the immediate job of simplifying and speeding up war production. A considerable part of the space is reserved for Government exhibits of interest to contractors and sub-contractors.

The exhibition will be held in the Milwaukee Auditorium, where the technical sessions of the Society will also be held. There will be six technical sessions during the three days of the meeting. These sessions will cover the subjects of "Women in Machine Shops"; "Increasing Tool Life"; "Tool Salvage"; "Machining of NE (National Emergency) Steels"; "New Production Methods"; and "Tool Engineering." Among the various subjects that it is planned to discuss are the new problems created by increased mass production of both ferrous and non-ferrous aircraft parts, the use of plastic tools, glass plug and ring gages, application of induction hardening processes, and developments in welding applicable to war production.

Another valuable feature of the meeting will be the showing of training films produced both by industry and the Government. Such films as are considered to be of particular value in the training of new workers will be shown in a room especially set aside for the purpose in the Auditorium. These training films have been found of great value in providing primary educational information for new workers.

Manhattan Rubber Celebrates Fiftieth Anniversary

THE Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., Passaic, N. J., celebrates this year its fiftieth anniversary, the company having been founded in 1893 under the name "The Manhattan Rubber Mfg. Co." While the company's progress has coincided with the great American era of industrial expansion, its growth has been gradual and conservative. The plant now employs about 4000 people and covers an area of more than a million square feet. The company has become one of the largest manufacturers of mechanical rubber goods, including conveyor and transmission belting, V-belting, hose, molded goods, rubber-covered rolls, and rubber-lined tanks. The concern is also prominent as a maker of asbestos friction materials and abrasive wheels.

It is of interest to note that two of the executives and several employes have been with the company for more than forty-five years. The two executives are F. L. Curtis, now vice-president and treasurer of Raybestos-Manhattan, Inc., who was manager of the company's original factory office, and C. T. Young, now factory manager, who was assistant to Mr. Curtis in the early days.

Electric Motor Record Card for Maintenance Men

Maintenance engineers can obtain from the General Electric Co., Schenectady, N. Y., a motor record card (GES-1526A), 4 by 6 inches, suitable for card files and containing spaces on both sides for recording essential information relating to each motor installed in a plant. Space is also provided for recording the nature and extent of inspections and repairs. With such a card system, the maintenance engineer has the history of all motors at his finger tips. If any motor requires an undue amount of attention, it can be seen at a glance, and the causes determined and corrected.

Information to Aid Industrial Scrap Collection

A 16-page booklet, 8 1/2 by 11 inches, entitled "Primer of Industrial Scrap," has been published by the Business Press Industrial Scrap Committee, Empire State Bldg., New York City. This booklet will prove of great assistance to industrial plants where the scrap collection problem and the methods involved are not fully understood. The publication contains five sections as follows: The Why and Wherefore of Scrap; Plant Salvage is Good Business; Scrap Definitions; Government Ceilings and Dealer Scrap Prices; and Statistics on Scrap Consumption and Steel Production.

Lubricants Containing Soap and Soap Solutions

As the war production program proceeds, lubricants become more and more important, and many new types are being developed to meet emergency needs. In many of these new lubricants, as well as in the older types, common soap is an important constituent. It is an important part of heavy-duty greases, bearing and piston lubricants, gear and transmission greases—to mention only a few applications. It is also a component of cooling and lubricating fluids for metal cutting, wire drawing, and deep drawing of metals.

Greases are essentially mixtures of some type of soap and petroleum oil, and may also contain glycerol (to reduce friction) and phosphates or organic sulphur compounds (to increase the strength of the oil film). The addition of soap to mineral oil gives it greater stability, increases its film strength, and, when used in small amounts, decreases friction. In the liquid greases used in automobile engines, soap reduces the tendency of piston-rings to stick and retards the formation of carbon deposits.

Modern warfare requires greases that maintain their properties fairly constant over a wide range of temperatures. A grease might be of proper viscosity at high operating temperatures, but so thick at room or outdoor winter temperature that an engine would have difficulty in starting or picking up speed. On the other hand, a lubricant satisfactory at room temperature might be so thin at the high operating temperatures that it would leak out from the system, with the result that the machine bearing would be ruined. Furthermore, the grease must retain its properties for a reasonable length of time—that is, it must wear well.

For gears and anti-friction bearings, particularly where the stress is not severe, a grease that is soft throughout a wide range of temperatures is desirable. To prepare such a grease, heat a mixture consisting of lubricating oil, from 10 to 50 per cent rape-seed oil, a small amount of an oil-soluble alkali salt of a sulphonic acid, and aqueous sodium hydroxide until the rape-seed oil is converted to soap. The mass is heated to remove the water, and additional mineral oil is added at about 500 degrees F.

Cutting Fluids Containing Soap

The common cutting fluids are emulsions of mineral oils in water containing soap. Such mixtures have the advantage of a high heat capacity and low viscosity, and of being oily, cheap, and good for practically all kinds of metal cutting. A typical mixture contains 1/4 pound sal soda, 1/2 pint lard oil, 1/2 pint soft soap, and water enough to make 10 quarts. To a certain extent, water-soluble solutions are used to improve the visibility at the cutting area.

The general principle involved in the formulation of these oils is to use combinations of soap, water-soluble organic solvents, and water-insoluble oils. One such soluble oil contains thirty parts potassium soap (green soap), seven parts olein, two parts cyclohexanol, and thirty-two parts paraffin oil. Antiseptics to prevent infections and rust inhibitors (such as sodium nitrite) are also added.

Lubricants for Deep-Drawing and Wire-Drawing Dies

To prevent sticking and wear of dies, various types of lubricants are used. For deep-drawing of high brass, an emulsion of 66.5 per cent mineral oil, 19.75 per cent common soap, 2.2 per cent ammonia soap, and 11.5 per cent water has been recommended. For drawing sheet metal, a mixture of anhydrous soap in mineral oil is stated by one investigator to be an unusually good lubricant.

In wire-drawing operations, too, ordinary soap plays an important part. One drawing lubricant contains varying proportions of a vegetable soap, ferrous oxide, and saturated lime water. This lubricant is said to form a durable coating on the wire, which prevents oxidation and maintains a high polish. Another wire-drawing emulsion which permits high-speed work contains 1 pound sodium alginate (a soap-like substance), 4 pounds tallow, 2 pounds soap, and 195 pounds water.

* * *

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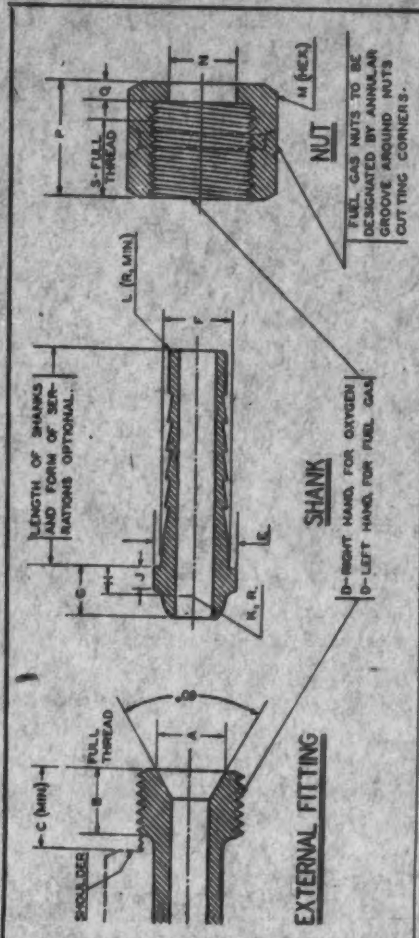
AMERICAN NATIONAL STANDARD HOSE CONNECTIONS FOR WELDING AND CUTTING TORCHES



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A	3/16, 1/8	0.250 ± 0.005	1/4	9/32	3/8–24	0.326 ± 0.002	0.248 — 0.005	1/4	0.182 ± 0.005
B	3/8, 5/16 1/4, 3/16, 1/8	0.433 ± 0.005	5/16	13/32	9/16–18	0.498 ± 0.002	0.430 — 0.005	5/16	0.175 ± 0.005
C	1/2, 3/8 5/16, 1/4	0.625 ± 0.005	11/16	23/32	7/8–14	0.750 ± 0.004	0.578 — 0.010	7/16	0.250 ± 0.005
D	3/4, 5/8 1/2, 3/8	0.954 ± 0.008	7/8	31/32	1 1/4–12	1.136 ± 0.004	0.875 — 0.010	5/8	0.327 ± 0.008

Class	For Hose Sizes	Shank: Length of Shoulder J	Shank: Radius K	Shank: Radius L	Nut: Width across Flats M	Nut: Diameter of Hole N	Nut: Length Over All P	Nut: Length of Hole Q	Nut: Depth of Full Thread S
A	3/16, 1/8	1/8	0.099	1/32	7/16	0.257 + 0.003 — 0.000	15/32	3/32	1/4
B	3/8, 5/16 1/4, 3/16, 1/8	1/8	0.196	3/64	11/16	0.4375 + 0.003 — 0.000	5/8	1/8	5/16
C	1/2, 3/8 5/16, 1/4	3/16	0.280	1/32	1 1/8	0.5937 + 0.006 — 0.003	1	5/32	11/16
D	3/4, 5/8 1/2, 3/8	3/16	0.438	3/64	1 1/2	0.9062 + 0.006 — 0.002	1 11/32	7/32	15/16

Compiled by National Bureau of Standa
U. S. Department of Commerce

AMERICAN NATIONAL STANDARD GAS-CYLINDER VALVE-OUTLET THREADS*

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Hydrogen, nitrogen, or helium	0.803"–14NS–2LH	0.8300	0.8200	0.7836	0.7786	0.7424	5/
Acetylene	0.835"–14NS–3	0.8350	0.8290	0.7780	0.7740	0.7368	5/
Ethyl-chloride	1/2"–14NPS form	0.8350	0.8290	0.7780	0.7740	......	....
Anhydrous ammonia	3/8"–18NPT (internal)	......	......	......	......	......	....
Dichloro-difluoro-methane .	3/4"–14NPS form	1.031	1.025	0.9717	0.9677	......	....

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Lubricants Containing Soap and Soap Solutions

AS the war production program proceeds, lubricants become more and more important, and many new types are being developed to meet emergency needs. In many of these new lubricants, as well as in the older types, common soap is an important constituent. It is an important part of heavy-duty greases, bearing and piston lubricants, gear and transmission greases—to mention only a few applications. It is also a component of cooling and lubricating fluids for metal cutting, wire drawing, and deep drawing of metals.

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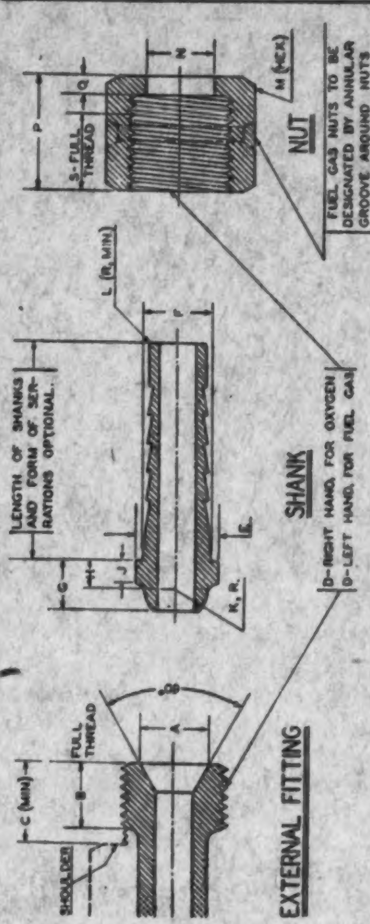
MACHINERY'S DATA SHEETS 485 and 486

AMERICAN NATIONAL STANDARD HOSE CONNECTIONS FOR WELDING AND CUTTING TORCHES



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MACHINERY'S Data Sheet No. 485, March, 1943

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MACHINERY'S Data Sheet No. 486, March, 1943

Compiled by National Bureau of Stand
U. S. Department of Commerce

Shear Type Tools and How to Use Them

By FRED W. LUCHT, Engineer
Carboloy Company, Inc.

WITH the introduction of some of the extremely tough alloy-steel castings for war equipment, it was found that carbide tools would have to be used extensively in order to obtain satisfactory production. Since many of the castings required interrupted cuts, some difficulty was at first experienced in obtaining high cutting speeds.

Some years ago, tools with an extreme negative back rake were applied successfully, but little general attention was paid by industry to this development, in view of the general lack of interest at that time in carbides for steel cutting. About a year ago, when the demand for carbides for the machining of steel began to rise, it was discovered that shear type tools had been developed by the Northern Pump Co. and were doing an outstanding job in machining certain ordnance parts. Since that time cemented-carbide shear type tools have been successful in eliminating many a bottleneck on interrupted steel cutting jobs, handling such work on a more economical basis even than the "conventional" single-point tools, although the latter were lower priced.

When properly applied, the shear type tool effectively meets the problem of interrupted steel cutting with carbides. Fundamentally, what the tool does is to enable the entire cutting edge of the tool to enter the cut ahead of the nose radius of the tool. Since the nose radius is normally the weakest part of any tool, the shock load in interrupted cutting is thus transferred from the nose to a stronger portion of the tool. As a result, the nose radius practically never breaks down first when a shear type tool is used, and the tool holds its size over longer cuts. It also permits the use of a smaller nose radius than would otherwise be the case, which, together with a relatively large side rake, imparts to the tool good free cutting action.

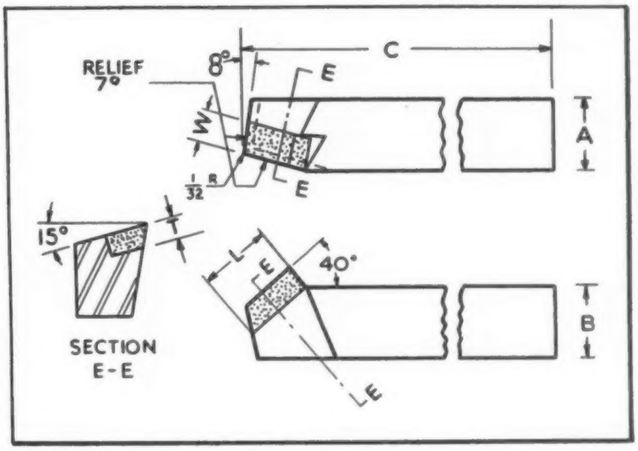


Fig. 1. Shear Type Tools are Characterized by an Unusually Large So-called "Negative Back Rake"

Advantages of Shear Type Tools

In general, the major advantage of shear type tools is that they will withstand more shock and impact load than standard tool types when tak-

Type of Tool	Tool Design Data: Size of Square Shank, Inches	Back Rake, Degrees	Side Rake, Degrees	End Cutting Angle, Degrees	Cut: Diameter, Inches	Depth, Inches	Speed: Rev. per Minute	Feet per Minute	Feed, Inches	Power Requirements: Motor Input, Horse-power	Increase, Horse-power	Approx. Increase, Per Cent
T-1310...	1 1/4	0	8	15	11	1/8	98	280	0.015	6	—	—
Shear....	1 1/2	40, neg.	15	8	11	1/8	98	280	0.015	8	2	30
T-1310...	1 1/4	0	8	15	11	1/4	98	280	0.030	18	—	—
Shear....	1 1/2	40, neg.	15	8	11	1/4	98	280	0.030	22.5	4.5	25
T-1310...	1 1/4	0	8	15	6 3/8	7/16	162	269	0.030	30	—	—
Shear....	1 1/2	40, neg.	15	8	6 3/8	7/16	162	269	0.030	34	4	13
Shear....	1 1/2	40, neg.	18*	8	6 3/8	7/16	162	269	0.030	34	4	13
Shear....	1 1/2	40, neg.	25†	8	6 3/8	7/16	162	269	0.030	32	2	6.7

*Cuts freer than tool with 15-degree side rake.
†Cuts freer than tool with either 15- or 18-degree side rake.
Both the T-1310 and the shear type tool had a side cutting angle (lead angle) of 15 degrees; a relief angle of 7 degrees; and were made from Grade 78-B Carboloy. Nose radius of all tools, 1/32 inch.

Fig. 2. Comparative Performance of Standard Type Turning Tool and Shear Type Tool

ing interrupted cuts. This ability to take abuse enables them also to stand up better when the material is scaly or impregnated with sand pockets and hard spots.

Ability to withstand shock means that they can be operated at higher cutting speeds and feeds than standard tools for interrupted cuts. In addition, the shape of the tool reduces the impact on the machine. This is particularly true when the tool is mounted in rams with considerable overhang. On quite old machines, where there is considerable backlash, shear type tools present a definite advantage in this respect. It should be pointed out in this connection, however, that shear type tools have a tendency to use more power than conventional tools for the same feed, speed, and depth of cut.

For continuous cuts, on the other hand, shear type tools will produce a chip that may be difficult to handle. Up to the present, ground-in chip-breakers have not proved generally satisfactory, since the tool directs the chip toward the finished cut. For this reason, the shear type tool is also not so suitable for finishing cuts as it is for roughing—since the chip may tend to mar the finished surface.

While satisfactory on most facing cuts, shear type tools cannot be run in as close to the center as standard tools because the nose radius lies too far behind the center in a tool with considerable negative back rake.

"Standard designs" of shear type tools are now available in shank sizes 1 inch square or larger. Smaller shank sizes are not generally recommended, due to the decreased shank support below the carbide tip.

Design of Shear Type Tools

Fig. 1 shows the "standard design" shear type tool adopted as a result of extensive experimental production work in the field. It will be noted that the main characteristic of the tool is a 40-degree negative back rake, together with a 15-degree side rake. The tip is mounted in such a way that it projects somewhat above the top of the shank, this design providing increased support below the nose of the tool with the large negative back rake used.

While the 15-degree side rake appears satisfactory for most types of cuts in which shear type tools have been used, an increase in side rake beyond this amount has a tendency to reduce power consumption, as might be expected from the freer cutting action. The comparison between the performance of a standard turning tool and a shear type tool given in Fig. 2 was based on the use of a Carboloy standard tool from which the chip-breaker had been removed, all operating conditions in the machining of a steel billet being duplicated.

It has been found that the best results have been obtained with shear type tools when using Carboloy Grade 78B, with the cutting edge along the lead angle stoned to remove the feather edge. When stoning, incidentally, it is advisable to remove the wheel feed marks along the face and relief angles. The stoned edge should be in the shape of a land approximately from 0.002 to 0.005 inch wide and at an angle of 45 degrees to the direction of feed.

When there is a tendency for the cutting edge to chip, this chipping action can be decreased by reducing the free cutting action of the tool. Indications are that this can be accomplished by decreasing the side rake slightly. In contrast, if the cutting edge tends to run too hot, and even begins to glow, a free cutting action can again be obtained by increasing the side rake a slight amount.

Applications of Shear Type Tools

When standard type tools are used to take intermittent cuts on a vertical boring mill with a large ram overhang (see Fig. 3), there is a tendency for the tool and ram to develop vibration in the direction of the feed, as indicated by arrow *A*. In contrast, when a shear type tool is mounted in exactly the same position, the vibration is generally reduced to practically zero.

Fig. 4 shows a sketch of a part made of a particularly tough alloy-steel casting on which the outside was turned, both ends faced, and the flat planed. The first of these operations was performed on a 60-inch vertical boring mill in good condition, with the tool mounted in the side-head and the ram having an overhang of 19 inches. It was found that the entire part could easily be machined without

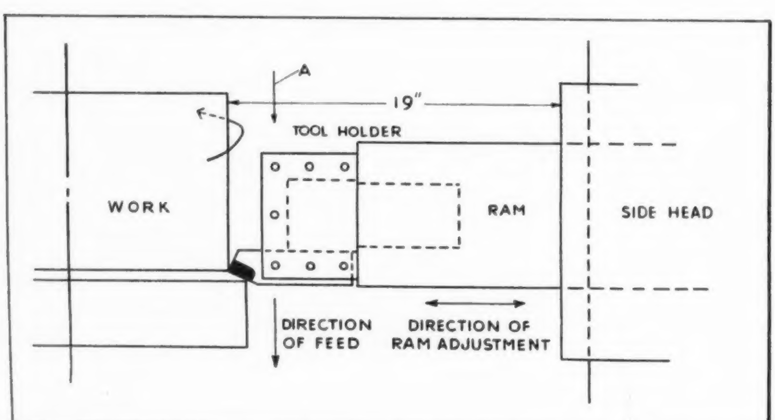


Fig. 3. Arrangement where Shear Type Tools Virtually Eliminate Vibration in the Direction of Arrow A, thus Permitting Higher Cutting Speeds

Fig. 4. Parts Such as the One Illustrated, Made from Very Tough Alloy Steel, are Most Advantageously Machined with Shear Type Carbide Tools. Fig. 5. In Machining This Part, Best Results were Obtained with a Shear Type Tool Having a Somewhat Smaller Negative Back Rake than Usually Employed. Fig. 6. This Type of Interrupted Cut was Handled on a 35-year Old Boring Machine by Using Carbide Shear Type Tools

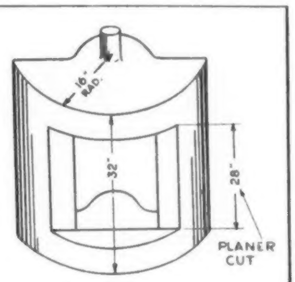


Fig. 4

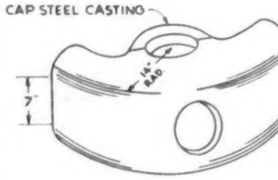


Fig. 5

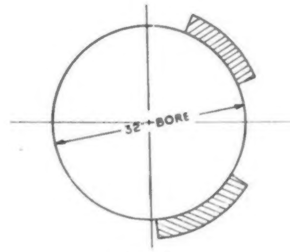


Fig. 6

regrinding the tool, using a feed of 0.015 inch per revolution, a depth of cut ranging from 1/4 to 3/4 inch, and a cutting speed of 200 feet per minute.

The bottom end of this part was faced on the same machine, with the tool mounted in the right-hand vertical ram. The speed, feed, and depth of cut were approximately the same as those employed for the turning operation.

A vertical turret lathe was used for facing the top end of this tough casting. This machine was considerably lighter, and the speed was reduced to 158 R.P.M. The last operation, planing the flat, was performed on a planer. The cutting speed was 50 feet per minute, and the cutting time was reduced from 8 hours to 3 hours. The feed in this case was from 0.045 to 0.050 inch, with a depth of cut of from 1/4 to 5/8 inch.

Another application in which good results were obtained with a considerably smaller negative back rake is illustrated in Fig. 5. The operation in this case consisted of facing the top and bottom of a tough alloy-steel casting. Two castings were mounted on a vertical turret lathe for simultaneous machining. A Carboloy standard T-1410 tool was used, with the back rake ground to a 5-degree negative angle. With a cutting speed of 240 feet per minute (at the beginning of the cut) and a depth of cut of roughly 1/2 inch or more, both castings could be machined on both sides without regrinding the tool. The finish near the inside was not so good as at the beginning of the cut, since the speed dropped to 94 R.P.M. and the negative back rake placed the nose of the tool considerably back of the center.

The same part was turned on the same type of machine with a shear type tool mounted in the side head. The ram overhang in this case was 16 inches. With a cutting speed of 197 feet per minute, a feed of 0.015 inch, and a depth of cut of from 1/4 to 3/4 inch, several castings could be turned before the tool required regrinding.

An example of machining an extremely tough part on an old machine is illustrated in Fig. 6. The job was to bore the 32-inch inside diameter with an interrupted cut. The machine was a thirty-five-year old horizontal locomotive cylinder boring machine in very bad condition. Some gear teeth were broken, while the spindle actually had a 1/16-inch play. The electrical system was in no better condition. The work was clamped to the table, poorly supported, using shims and jacks. In short, this was just the combination of conditions that would make the successful use of a carbide tool seem highly improbable. To meet this set of conditions, the tools were provided with a 60-degree lead angle instead of the usual 15 degrees to compensate for the upward lift of the spindle resulting from the bad bearings of the machine.

Two tools were inserted in a 28-inch diameter cat-head, mounted on an 8-inch diameter bar, with an overhang of 32 and 40 inches. The maximum safe speed was only 10 R.P.M. for a surface speed of 83 feet per minute. The lowest available feed per tool was 0.021 inch. The depth of cut was roughly 3/8 inch. With this set-up the shear type tools produced two to three complete pieces per tool grind.

It might be mentioned that all the castings referred to were not only very tough, but also scaly and well impregnated with sand pockets and hard spots. In addition, some portions of the castings had glassy hard surfaces caused by previous flame cutting.

* * *

The volume of freight traffic handled by the Class I railways of the United States in 1942 has reached a new high level. In the first eight months of the year 1,808,228,258 tons of freight were carried, which represented an increase of 25 per cent compared with the corresponding period in 1941. Since, however, the average haul per ton of freight transported was 9 per cent greater than in the same months of 1941, the actual increase in ton-miles amounted to 36 per cent.

MATERIALS OF INDUSTRY

THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

New Plastic Insulation Releases Vital War Materials

A new plastic fiber that will take the place of phenol fiber, hitherto widely used as an insulating material, has been developed by the Western Electric Co. The new product is being made out of the water waste resulting from the manufacture of sulphite paper. Its use has enabled such war-essential components of phenol fiber as cresylic acid, formaldehyde resin, and paper to be diverted to military needs. This plastic, known as Lignin, now takes the place of phenol fiber in about two-thirds of its former applications in the company's plants.

The Lignin is received at the Western Electric plants in the form of paper sheets. These are conditioned to a definite moisture content, heated, and subjected to high pressures, so that a tough fiber board is formed, which, pound for pound, has the strength of steel. The material possesses good electrical characteristics, is less corrosive than phenol fiber, can be readily punched, and has many of the other properties of phenol fiber board. 201

Electrolytic Process Helps to Conserve Tin

Normally, this country consumes more than one-third of the world's output of tin, while producing virtually none. In 1939, for example, less than 40 tons of tin was mined in the United States, although we used 73,000 tons. The total amount of tin mined in the world was 172,000 tons. The Japanese now control the sources of two-thirds of the world's tin output, thereby creating a serious war problem for the United States.

The tin requirements in this country in 1943 will be approximately 16,000 tons less than in 1941, as a result of wartime measures. Tin plate is no longer available for containers for dog food, beer, peanuts, and other products that can be placed in containers made of other materials. Cans of small sizes have been eliminated. Oil and other liquids now come in cans made of lacquered black iron or terne plate.

The next attack on the tin problem has been to reduce the amount of tin in tin-plated steel. Tin plate made by dipping steel sheets into molten tin ordinarily takes 1 1/2 pounds of tin for every 100 pounds of steel. To reduce this amount, electrolytic tinning methods have been developed requiring only 1/2 pound of tin for 100 pounds of strip. The electrolytic process has other advantages; it is faster and the coating is applied uniformly.

A new high-frequency method of fusing tin, designed as the final step in making electrolytic tin plate, has been developed by Westinghouse research engineers. By means of high-frequency induction heating, a smooth shiny corrosion-resisting finish is produced on tin plate. . . .202

Synthetic Resins Replace Rubber Insulation

Widely used as a substitute for rubber insulation in the field of wire and cable is a series of synthetic resins and plasticized compounds manufactured by the Carbide and Carbon Chemicals Corporation, 30 E. 42nd St., New York City, under the name Vinylite. These synthetic insulations are now being used for most of the purposes previously served by rubber. They are applied either as extrusion compounds or as a film compound.

The former are coated on the wire or cable core by means of a specially designed extruder which causes the plastic resin to form itself around the wire or cable in a uniform insulating wall of the thickness desired. The extrusion compounds are also fabricated in the form of tubing, which may be slipped over the wire or cable to serve as an over-all jacket or which may serve as a duct into which the wire or cable may subsequently be drawn.

The film compound is formed by calendering the plastic into a sheeting of the desired thickness, which is slit into tape of various widths. This is supplied in roll form for wrapping wire and cable in manufacture or installation.

Many advantages are claimed for this new type of insulation. It has superior aging properties, and will not deteriorate during years of

To obtain additional information about materials described on this page, see lower part of page 176.

service, even in hot, humid tropical climates. It is highly resistant to normal weathering conditions, and has low moisture absorption and high dielectric and tensile strength. Certain types of Vinylite plastic insulation will not support combustion. Another special jacketing compound will remain flexible at temperatures down to — 50 degrees F. Other advantages are abrasion resistance, chemical resistance, and resistance to oils and greases. 203

Coating to Prevent Adhesion of Welding Spatter

A liquid for the prevention of adhesion of welding spatter, known as "No-Spat," has been placed on the market by the Midland Paint & Varnish Co., 9115 Reno St., Cleveland, Ohio. This liquid is brushed over the seam and area where the weld spatter is likely to fall. After welding, the spatter may be wiped away; no chipping or grinding is necessary. It is claimed that the "No-Spat" liquid fuses with the molten metal and improves the tensile strength by carrying off impurities and preventing porosity. It also acts as a rust protector, will not freeze, and can be used over the full welding range of amperage and voltage. 204

Rubber-Stamp Fluid for Metal Marking

Using an ordinary rubber stamp, dies, tools, and finished parts can be quickly and easily marked with identification numbers or symbols by means of a new marking fluid designated as "Rives Metal Marker." This product, manufactured by Metalscript, 1011 Talcott Bldg., Rockford, Ill., provides a permanent marking, which does not wash or rub off. The fluid can be put on an ordinary stamp pad and the stamp handled in the usual way. The present formula is intended primarily for marking most ferrous metals and copper. Other fluids for marking bronze, brass, aluminum, and steel alloys containing special hardening elements are to be made available later. 205

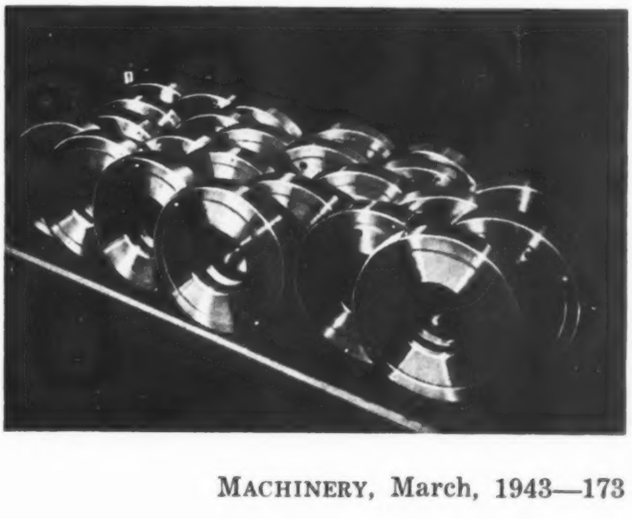
"Xcel-Flux SS"—a New Silver Solder Flux

A new silver solder flux, known as "Xcel-Flux SS," has been developed by the American Products Corporation, 422 S. Dearborn St., Chicago, Ill. This flux has a breaking point of approximately 920 degrees F., and becomes completely fluid at 1065 degrees F. While under the torch, it throws off a green transparent flame that permits the operator to have a full view of the work. It is claimed that this flux will stay firm when mixed with water, and will not crystallize or harden when sealed in jars. It meets the requirements of U. S. Navy Specification No. 51F4a. 206

Wheel-Dressing Compound for Wet Grinding

A compound intended to increase the efficiency of wet grinding operations has recently been developed by the Wolfe-Kote Co., Sheboygan, Wis. This compound, designated "Ever-Drest," is added to the grinding wheel water in the proportion of one pound to each five gallons of water. The effect of the compound is to reduce the surface tension of the water and to keep the pores of the wheel open. Its use is claimed to prevent burning of the wheel surface and to increase wheel life considerably.

The compound works equally well with organic or vitreous wheels and with hard or soft water. It permits the use of closer-grained wheels for better finishes. It can be used with soluble oils where desired, but they are not needed in most cases. 207



The six sets of four dies each here shown were made by the Carboloy Company, Inc., Detroit, Mich., and will be used in the production of some 1,000,000 steel shell cases. The adoption of drawing dies with extremely hard cemented tungsten-carbide centers has facilitated the conversion of shell manufacture from brass to steel.

To obtain additional information about materials described on this page, see lower part of page 176.

NEW TRADE LITERATURE

RECENT PUBLICATIONS ON MACHINE SHOP EQUIPMENT, UNIT PARTS, AND MATERIALS

To Obtain Copies, Fill in on Form at Bottom of Page 175 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the March Number of MACHINERY

Machining Stainless Steel

RUSTLESS IRON AND STEEL CORPORATION, Baltimore, Md. Booklet entitled "Shop Notes on the Machining of Stainless Steel," containing instructions on the proper methods of machining stainless steel, based on actual shop data. The information covers turning, cutting off, forming, drilling, threading, reaming, and tapping, as well as the application of shave tools. 1

Small Tools

NATIONAL TOOL CO., 11200 W. Madison Ave., Cleveland, Ohio. First issue of a new publication entitled "Blueprints of the Future," to be distributed to users and to prospective users of National hobs, gear-cutters, milling cutters, broaches, and other tools. This publication will contain articles dealing with the future of industry, science, and economics, and the probabilities of the post-war world. 2

Kennametal Tool Manual

MCKENNA METALS CO., 147 Lloyd Ave., Latrobe, Pa. Vest-pocket manual containing 52 pages of complete data on the care, handling, and most efficient methods of using Kennametal tools, including more than 100 drawings illustrating tool applications, operations, tool styles, instructions for grinding, tool design, and brazing blanks to used shanks. 3

Heat-Treating Equipment and Electrical Measuring Instruments

LEEDS & NORTHRUP CO., 4921 Stenton Ave., Philadelphia, Pa. Latest copy of *Modern Precision* contains articles describing applications of Micromax pyrometers and other L&N electrical measuring instruments, automatic control, and heat-treating furnaces both for war production and essential peacetime work. 4

Tapping Machines

BAKEWELL MFG. CO., 2023 Santa Fe Ave., Los Angeles, Calif. Catalogues illustrating and describing three Bakewell precision-production tapping machines—the No. 1 with capacity for tapping 4-40 to 5/8-inch holes in steels; the 1-R radial for the same size holes in large bulky work; and the No. 2 for holes from 3/8 to 1 1/2 inches in steels. 5

Recording Thermometers

WHEELCO INSTRUMENTS CO., Harrison and Peoria Sts., Chicago, Ill. Bulletins G503-2, G603-2, and G403-2, describing industrial recording and indicating control thermometers. Bulletin G23-2 containing information to aid the user in selecting the proper control thermometer for a given application. 6

Lubrication of Ball and Roller Bearings

LUBRIPLATE DIVISION OF FISKE BROTHERS REFINING CO., 129 Lockwood St., Newark, N. J. Bulletin 1-43, containing information of value to operating and maintenance engineers relating to the installation, care, and lubrication of ball and roller bearings. 7

Adjustable Dies

S. B. WHISTLER & SONS, INC., 752-756 Military Road, Buffalo, N. Y. Twenty-fifth anniversary catalogue containing important information on adjustable dies and their use in speeding up war production, as well as other Whistler tools and special machinery. 8

Deep-Hole Drilling and Boring Machines

W. F. & JOHN BARNES CO., Rockford, Ill. Circular containing complete information on the W. F. & John Barnes 445 two-spindle deep-hole drilling and boring machine, designed to drill or bore two parts simultaneously in completely independent cycles. 9

Industrial Cleaning Equipment

OAKITE PRODUCTS, INC., 26 Thames St., New York City. Booklet describing how steam-detergent cleaning is being used in the metal-working industries to conserve man-hours on a wide range of maintenance, repair, and overhaul work. 10

Increasing Life of Cemented-Carbide Tools

VASCOLOY-RAMET CORPORATION, North Chicago, Ill. Wall chart showing graphically four simple ways to get longer life from cemented-carbide tools, designed especially to aid workers in the war industries. 11

Electronic Tubes

GENERAL ELECTRIC CO., Schenectady, N. Y. Booklet entitled "Electronics—a New Science for a New World," describing the almost limitless field of electronic tubes in war combat; research; industry; agriculture; medicine, etc. 12

Heat-Treating Furnaces

R-S PRODUCTS CORPORATION, Wayne Junction, Philadelphia, Pa.

Bulletin 68-F, illustrating and describing R-S heat-treating car-hearth, direct-fired furnaces and convection type furnaces for stress-relieving and drawing. 13

Handbook of Copper, Brass, and Bronze Products

REVERE COPPER & BRASS, INC., 230 Park Ave., New York City. Sixth edition of a handbook for engineers and technical men, giving weights and other data on a variety of copper, brass, and bronze products. 14

Circuit-Breakers

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. Booklet DD-29-060, describing the complete line of "Nofuze" De-Ion circuit-breakers for lighting, distribution, and power circuits up to 600 amperes. 15

Sawing, Filing, and Lapping Machines

GROB BROTHERS, Grafton, Wis. Catalogue 10, covering the Grob line of sawing, filing, and lapping machines. Notching and sawing instructions, as well as data on saw-blade selection, are included. 16

Band Saws

WELLS MFG. CORPORATION, 404 S. Grant St., Three Rivers, Mich. Circular entitled "Saw It the Wells Way," illustrating and describing construction details and typical applications of the Wells metal-cutting band saw. 17

Jig Borers

MOORE SPECIAL TOOL CO., INC., Bridgeport, Conn. Bulletin M-130, illustrating and describing the Moore precision jig borer suitable for use in tool-rooms and jobbing shops making small and moderate-sized parts. 18

Machine Tools

ATLAS PRESS CO., 253 N. Pitcher St., Kalamazoo, Mich. Circular listing industrial plants and government departments equipped with Atlas lathes, drill presses, arbor presses, milling machines, and shapers. 19

Machine-Tool Sump-Tank Cleaning Machine

W. R. CARNES CO., Madison, Wis. Folder illustrating and describing equipment for cleaning sump tanks in a fraction of the time formerly required. 20

DoAll Contour-Cutting Band Saws

DOALL CO., 1215 Thacker St., Des Plaines, Ill., is distributing a calendar for 1943 containing on each sheet instructive data regarding the contour-sawing process. 21

Metal Duplicating Without Dies

O'NEIL-IRWIN MFG. CO., Minneapolis, Minn. Catalogue 43-4, describing the Di-Acro system of forming metal parts accurately without dies, and the equipment used. 22

Railroad Cleaning Handbook

MAGNUS CHEMICAL CO., INC., Department M, Garwood, N. J. "Railroad Cleaning Handbook," discussing the maintenance cleaning problems of the railroad industry, and their solutions. 23

Universal Tool and Cutter Grinders

MACHINERY MFG. CO., 1915 E. 51st St., Vernon, Los Angeles, Cal. Circular descriptive of the Vernon universal tool and cutter grinder and its attachments. 24

Automatic Control and Recording Instruments for Furnaces

BRISTOL CO., Waterbury, Conn. Series of bulletins covering automatic control and recording instruments for industrial furnaces, dryers, ovens, etc. 25

Wire Baskets

BUFFALO WIRE WORKS CO., INC., 445 Terrace, Buffalo, N. Y. Circular showing typical examples of the many different types of wire baskets designed by this company for a variety of purposes. 26

Precision Gages and Tools

AMERICAN GAUGE CO., 125 Bayard St., Dayton, Ohio. Bulletin 43, de-

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To Obtain Copies of New Trade Literature

listed on pages 174-176 (without charge or obligation), fill in below the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail to:

MACHINERY, 148 Lafayette St., New York, N. Y.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Name .... *Position or Title* ....

[This service is for those in charge of shop and engineering work in manufacturing plants.]

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Business Address ....

City .... *State* ....

[SEE OTHER SIDE]

scriptive of thread checkers, amplifying gages, hole checkers, bench centers, radius dressers, and lapping plates. 27

Wire-Rope Shears

WATSON-STILLMAN CO., Roselle, N. J. Bulletin 740-A, illustrating and describing wire-rope shears, made in both hand and hydraulic types, for cutting round and flat iron bars and wire cable. 28

Adjustable Spacers for Milling Cutters

DAVID J. ROSS CO., Benton Harbor, Mich. Circular descriptive of the Rousselle adjustable spacers designed to save time in setting up for straddle-milling operations. 29

Speed Reducers

JANETTE MFG. CO., 556 W. Monroe St., Chicago, Ill. Bulletin 22-27, covering the complete line of Janette speed reducers ranging from 1/50 to 10 H.P. in size, with speeds from 0.08 to 1140 R.P.M. 30

Selection of Files

NICHOLSON FILE CO., Providence, R. I. Booklet entitled "File Filosophy," prepared to help tool users select the right file and use it correctly. 31

Industrial Trailers and Trucks

YALE & TOWNE MFG. CO., Philadelphia, Pa. Bulletin entitled "Cut Trailer Cost 50 Per Cent and Speed Materials - Handling Operations with the Load King Trailer." 32

High-Production Presses

E. W. BLISS CO., 53rd St. and Second Ave., Brooklyn, N. Y. Catalogue 27, illustrating and describing Bliss high-production presses designed to handle a great variety of work. 33

How to Sharpen Taps

GREENFIELD TAP & DIE CORPORATION, Greenfield, Mass. No. 2 of a series of folders on "Taps and Tapping," containing detailed instructions for sharpening taps. 34

Diamond Wheels

J. K. SMIT & SONS, INC., 157 Chambers St., New York City. Price list covering many types and sizes of resinoid-bonded and metal-bonded diamond wheels. 35

Design of Plastic Parts

GENERAL ELECTRIC CO., Plastics Department, Pittsfield, Mass. New edition of a booklet containing technical information on the design of molded plastic parts. 36

Safety Equipment

BOYER CAMPBELL CO., 6540 Antoine St., Detroit, Mich. Catalogue 50, containing 144 pages covering industrial safety equipment, fully indexed. 37

Ampco Metal

AMPCO METAL, INC., Milwaukee, Wis. Engineering Data Sheet No. 108, giving case histories showing the wear resistance of Ampco metal. 38

Milling and Jig Boring Machines

LINLEY BROTHERS CO., Bridgeport, Conn. Bulletin illustrating and describing the Linley high-speed vertical milling and jig boring machine. 39

Carbide Tool Grinders

HAMMOND MACHINERY BUILDERS, INC., 1619 Douglas Ave., Kalamazoo, Mich. Bulletin 201, showing the company's complete line of carbide tool grinders. 40

Aviation Fittings and Valves

WEATHERHEAD CO., Cleveland, Ohio. Wall chart illustrating aviation fittings, hydraulic hose, valves, and other aviation accessories. 41

Wartime Care of Centrifugal Pumps

ALLIS-CHALMERS MFG. CO., Milwaukee, Wis. Handbook entitled "Wartime Care of Centrifugal Pumps." 42

Care of Electric Motors

DUMORE COMPANY, Racine, Wis. Bulletin 30, on the care and maintenance of Dumore fractional-horsepower motors. 43

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 177-198 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning machine as described in March, 1943, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on pages 172-173, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning name of material as described in March, 1943, MACHINERY.

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Detach and mail to MACHINERY, 148 Lafayette St., New York, N. Y.

[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Onsrud Automatic Contour-Milling Machine Built to Handle Long Work

The Onsrud Machine Works, Inc., 3940 Palmer St., Chicago, Ill., have developed a new type of automatic contour-milling machine for forming or shaping long billets and extruded sections of non-ferrous materials in sizes too large to be handled on conventional type milling machines. This machine, designated A80-A, is especially adapted for performing such contour-milling operations as are required in the production of aircraft spar beams, cap strips, and similar parts of unusual length and relatively large cross-section.

The beam or other long piece to be milled is held on the stationary bed, while the carriage, which carries the cutters, travels along the bed. The cutter-spindles are guided by templets or cams designed to give the work the required shape and size. The carriage has four cutter-heads. There are two horizontal cutter-spindles like the one shown in Fig. 2, one being located at each end of the carriage. Between the two horizontal cutter-spindles are two vertical spindles.

One of the vertical spindles, shown to the left in Fig. 3, can be tilted to any angle up to 15 degrees either toward the front or toward the rear of the machine. It can be set at the required angle or it can be automatically tilted at any point along the work traversed or at any number of points. This feature makes it possible to mill a twist or varying bevel surface on the work.

One of the templets by means of

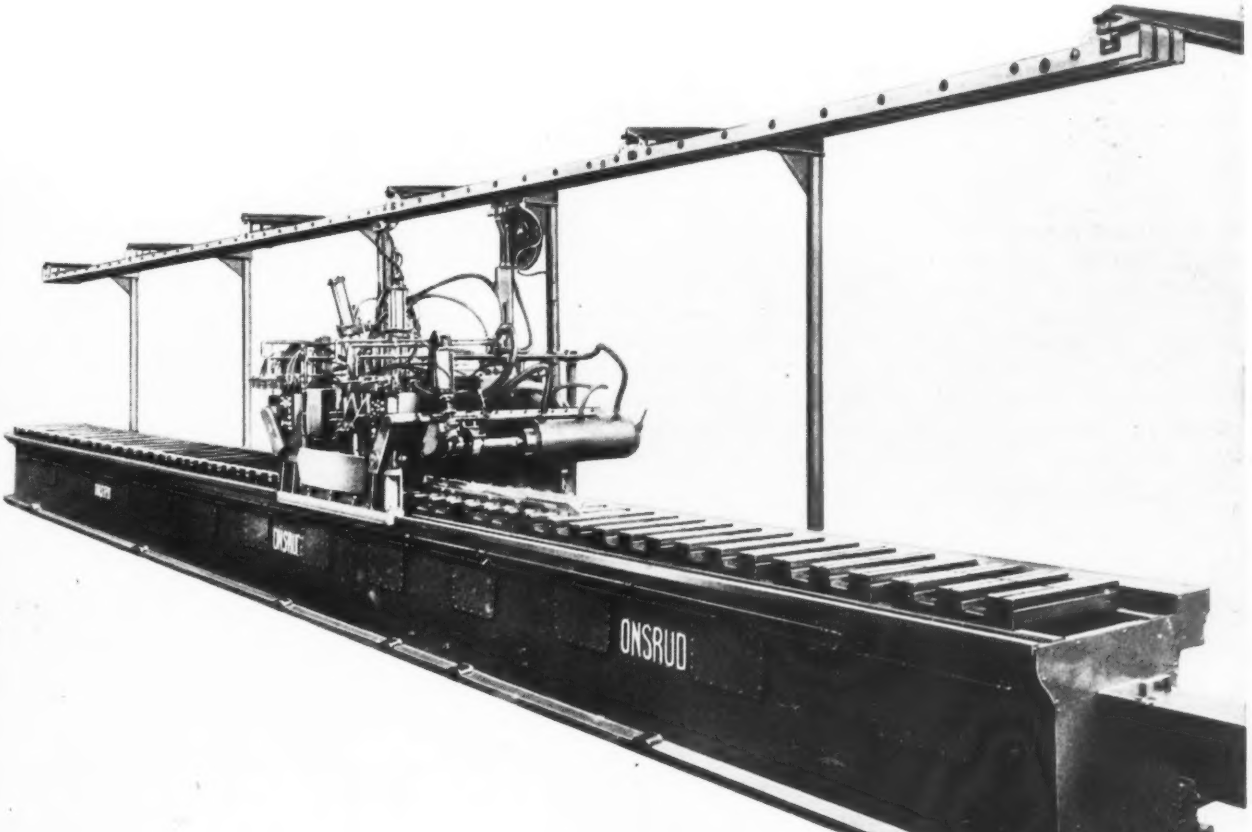


Fig. 1. Automatic Contour-milling Machine Designed and Built by the Onsrud Machine Works, Inc.

To obtain additional information on equipment described on this page, see lower part of page 176.

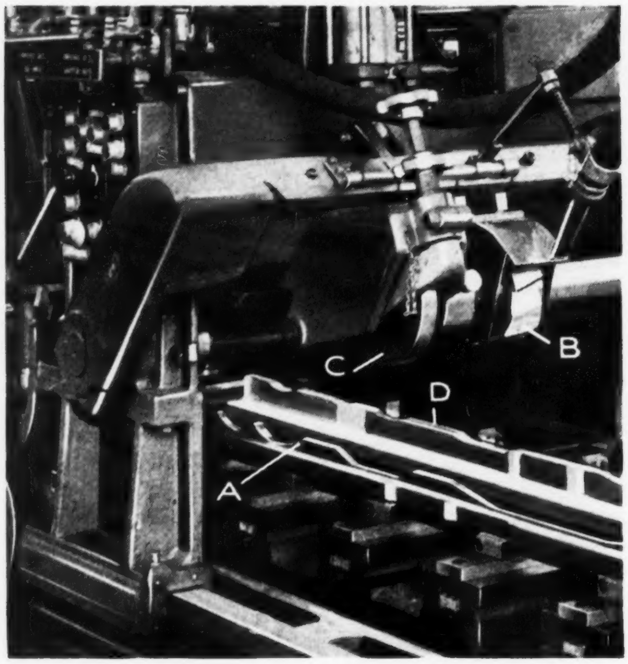


Fig. 2. Horizontal Spindle of Machine Shown in Fig. 1 with Templet A and Follower C Arranged for Milling Work D to Required Shape with Cutter B

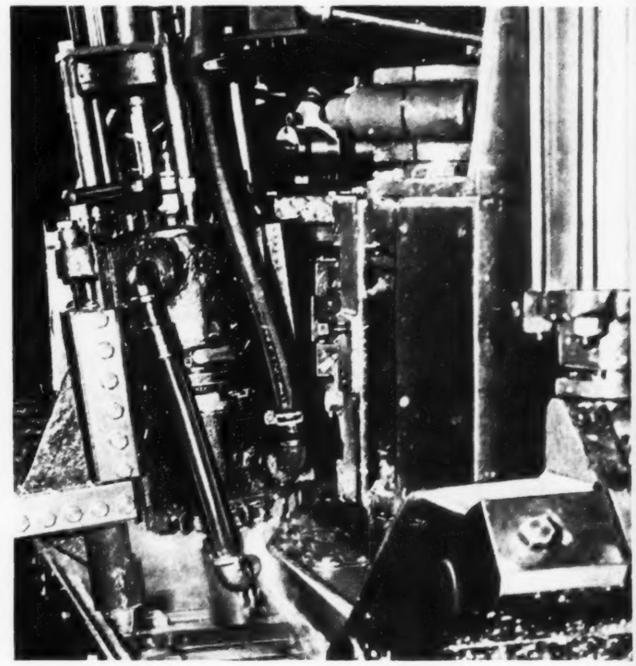


Fig. 3. Vertical Spindle of Onsrud Contour-milling Machine Arranged for Automatic Tilting to Produce Twist or Varying Bevel Surface on Work

which the work is automatically milled to shape and size is shown at *A* in the view of the right-hand horizontal spindle and motor assembly, Fig. 2. In operation, the entire assembly (including the motor, cutter-spindle, cutter *B*, and templet follower *C*) is pneumatically lowered and held down against templet *A* and work *D*.

As the carriage feeds forward, the templet follower rolls over the formed surface of the templet, causing the cutter to mill the work to the required shape. A similar templet and templet-follower arrangement causes the vertical spindles to move in and out during the traversing movement of the carriage to form-mill the side of the work to the required shape. The form of the templet is reproduced on the work with an accuracy of 0.001 to 0.003 inch.

A cam bar or templet at the rear of the machine base provides the control that automatically varies the feed of the carriage to suit the work. By means of this cam bar, the feed can be varied as required within a range of from 4 inches to 18 feet 6 inches per minute. Thus, the feed can be varied from a slow roughing to a fast finishing or "skip" feed.

The bed of the machine consists of cast-iron sections made in 7 1/2- and 15-foot lengths, which can be bolted together in any combination to obtain as long a bed as required. Table sections of 20-inch open-grate type construction are bolted to the ground surface of the bed. T-slots, spaced 9 inches between centers in the table, facilitate clamping the work by means of air or hydraulically operated clamps. This construction permits locating the clamps below the surface of the table.

The machine has an over-all width of 7 feet 8 inches; with a 45-foot bed it weighs about 52,000 pounds. The table is 24 1/2 inches wide, and its top surface is 36 1/2 inches above the floor. Horizontal cutters up to 9 inches and vertical cutters up to 3 inches can be employed. The working range from table to vertical motor is 2 to 11 inches, and from table to center of horizontal motor arbor, 3 1/4 to 11 1/2 inches. The maximum work clearance space is 7 inches high by 20 inches wide. 61

Countersink-Grinding Fixture

To meet the urgent demands for speed and accuracy in grinding countersinks used in aircraft manufacturing, the Industrial Grinding Co., 6423 McKinley Ave., Los Angeles, Calif., has brought out a new I-G-C relief-grinding fixture. It is claimed that this fixture will speed up grinding operations as much as 300 per cent. It will handle either right- or left-hand countersinks of all types, center drills, integral pilot cutters, and pilot drills. The fixture can be easily adjusted for correct relief and angle in relationship to the grinding wheel

Countersink-grinding Fixture Developed by the Industrial Grinding Co.

To obtain additional information on equipment described on this page, see lower part of page 176.

Greater Production from your No. 12s!

—USE THE DUAL FEED RATE

Save time on run-in —and on work where amount of stock removed varies during cut

We are proud to be honored with the Navy "E", awarded for outstanding accomplishment in Defense production.
Brown & Sharpe Mfg. Co.
Providence, R. I., U. S. A.
BS

Double or ***halve*** the selected cutting feed automatically at any desired point in the cut, as follows:

Double any of the 16 feed rates available from ½ to 17½ inches per minute.

Halve any of the 16 rates from 1 to 35 inches per minute.

KEEP MACHINES PRODUCING

- Keep them clean
- Lubricate regularly with proper oils
- Keep bearings and gibs adjusted

—A little consideration on your part will prevent unnecessary wear, breakdowns and repairs

These savings frequently **cut production time in half**—sometimes more—on your No. 12 Plain Milling Machines.

Deliveries Are Good on New No. 12's

BROWN & SHARPE

by means of two wrenches furnished for this purpose.

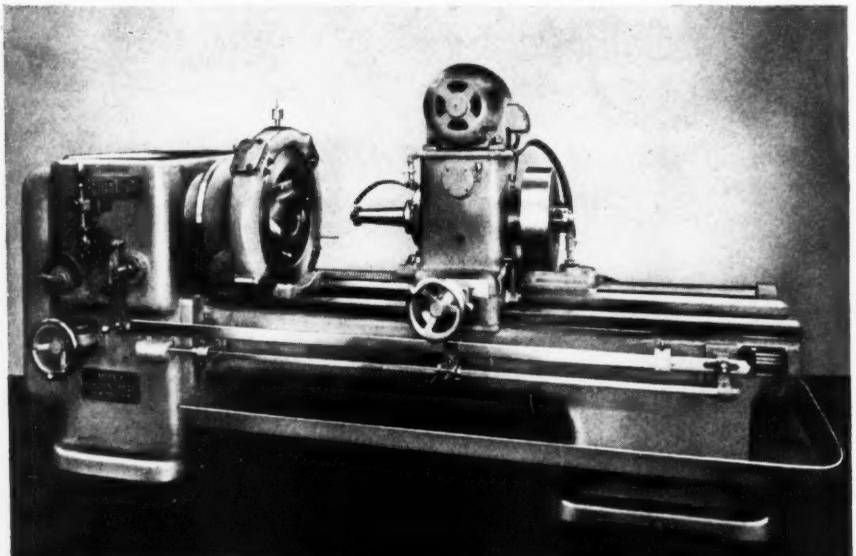
The fixture fits any standard grinder and will handle work from 1/16 to 1 inch in diameter with standard collets. The "lift" of the single cam is variable from 0.001 to 1/8 inch, and adjustment pins are provided for grinding cutters having one, two, three, four, six, and twelve flutes. The fixture can be swung 90 degrees to the right or left, and the base is calibrated in 5-degree increments. It is supplied with a Hardinge Type 5-C collet of 1/4 inch capacity, ready for attachment to the grinding machine. 62

Thread-Milling Machine Equipped to Handle Propeller Hubs

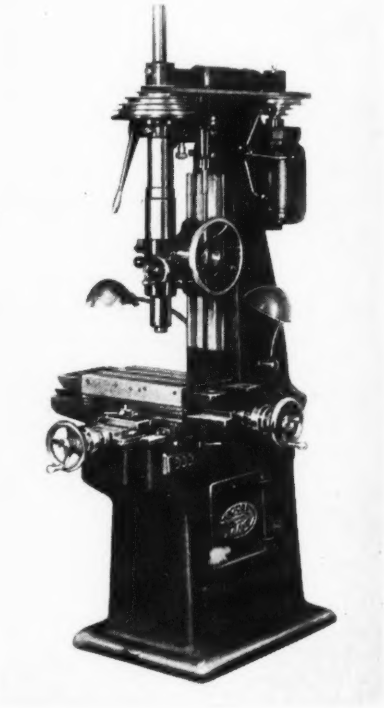
The Morey Machinery Co., Inc., 410 Broome St., New York City, has recently brought out one of its Morey-Shields thread-milling machines equipped with a special fixture for machining propeller hubs. As shown in the illustration, the propeller hub is held in a special chuck within a housing fitted to the machine bed. A special carriage with motor-driven threading-cutter spindle has been developed to insure accuracy and rapid production in milling the threads in the propeller hubs. This machine can be readily adapted for other work of a similar nature.

The maximum diameter of work on which threads can be milled is 12 inches. The machines are available with four different lengths of bed having maximum distances between centers of 30, 60, 90, and 120 inches. The hole through the headstock is 4 1/16 inches, but the diameter of the hole at the front end of the spindle can be increased to 8 inches and provided with a collet for holding work up to this diameter. The swing over the carriage is 12 inches, and over the ways 24 inches. The center height is 38 inches.

Single cutters for external threading range from 4 1/2 to 6 inches in diameter. Cutters for internal threading operations range from 1 to 4 inches in diameter. Four cutter-spindle speeds from 60 to 150 R.P.M. are available when a 900-R.P.M. motor is used. With a 1200-R.P.M. motor, there are four spindle speeds from 80 to 200 R.P.M. The machine taking work up to 30 inches in length between centers requires a floor space of 60 1/2 by 89 inches, and weighs 5800 pounds. The machine handling work up to 120 inches in length requires a floor space of 60 1/2 by 209 inches, and weighs 9600 pounds. Regular equipment for external threading includes motor-driven pump, tank, piping, steadyrest, follow rest, oil pan, index ring, 48-notch plate, 19 change gears, and wrenches. 63



Morey-Shields Machine Equipped for Milling Threads in Propeller Hubs



Jig Borer Developed by the Moore Special Tool Co.

Moore Jig Borer

The Moore Special Tool Co., Inc., Bridgeport, Conn., has developed a jig borer designed to meet the demand for greater accuracy and speed in spotting, drilling, reaming, and boring holes in one uninterrupted sequence of operations. This jig borer is especially adapted for use in tool-rooms and jobbing shops on tool and die work such as is required in the production of aviation instruments, clocks, locks, electrical devices, typewriters, and other products requiring small and medium-sized parts. It can be used for the sensitive boring of holes 1/32 inch or smaller in diameter, as well as larger holes. The maximum capacity of the machine with a 2-speed motor is 3 1/2 inches in tool steel, and 4 1/2 inches in soft steel. With a single-speed motor, the machine has a capacity for boring holes 2 inches in diameter in tool steel, and 2 1/2 inches in diameter in soft steel.

The lead-screws in the jig borer are corrected and checked under actual working conditions in the machine to which they are fitted. The machines are guaranteed to space and bore holes accurately within limits of 0.00025 inch in any position of the table.

To obtain additional information on equipment described on this page, see lower part of page 176.

The table has a working surface of 10 by 16 inches, a longitudinal travel of 14 1/4 inches, and a crosswise travel of 9 1/4 inches. The quill housing has a vertical adjustment of 9 inches, and the quill spindle has a travel of 3 7/8 inches. The distance from the spindle center to the column ways is 9 inches. There are ten spindle speeds with a two-speed motor, ranging from 100 to 2600 R.P.M. The complete machine with regular equipment, including the motor, weighs 1700 pounds, and requires a floor space of 36 by 44 inches. 64

Waterbury-Farrel Nut-Tapping Machine of Improved Design

The line of nut-tapping machines designed by the Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., to employ straight-shank taps, as described in April, 1938, MACHINERY, page 563, has recently been redesigned and improved to obtain increased production and greater versatility. The new machines are available in three sizes, as follows: No. 1, for tapping holes from 1/4 to 7/16 inch in diameter; No. 2, for holes 3/8 to 9/16 inch; and No. 3, for holes 5/8 to 7/8 inch. The improved hopper-fed mechanism has a selector device, designed for handling special slotted nuts, so that they will all face the same way when delivered to the stationary straight-shank tap.

The pusher mechanism, which advances each nut into the work-holding jaws, is entirely new and can be instantly withdrawn to permit the removal of any obstructions. The pusher tip has a ball bearing which allows it to rotate with the nut, thus preventing the surface from being marred. The feed-cam and change-gears are located within a casing and can be easily replaced. Safety devices stop the machine automatically to prevent tap breakage in case imperfect blanks or other obstructions interfere with normal operation.

The tap-holding and nut-stripping mechanism has also been redesigned. The tap is held in place by two pairs of clamping arms which open and close alternately. In Fig. 2, the left-hand clamps are shown closed on the shank of the tap, while the right-hand pair is open. The open pair closes before the left-hand pair opens, thus the tap is always held securely by one of the two clamps. The tapped nuts are intermittently pushed along the tap shank by a pair of vertical spring fingers and two horizontally actuated claws assembled in a reciprocating slide. The claws fulcrum in the slide and are synchronized to operate with the opening and closing movements of the clamps. The tapped nuts simply drop off the end of the tap into a trough. 65

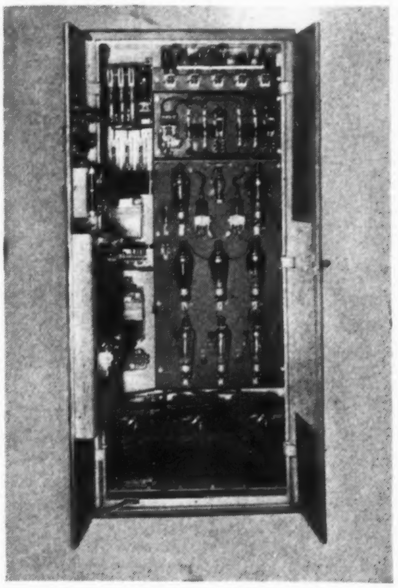


Fig. 1. General Electric Control for the Resistance-welding of Aluminum

General Electric Electronic Controls for Welding

Simplified construction is one of several important features of a new electronic capacitor discharge resistance-welding control brought out by the General Electric Co., Schenectady, N. Y., for the resistance-welding of aluminum. This construction not only eliminates much vital material, but also facilitates thorough inspection and servicing. The new control, shown in Fig. 1, employs the energy-storage principle for performing all func-

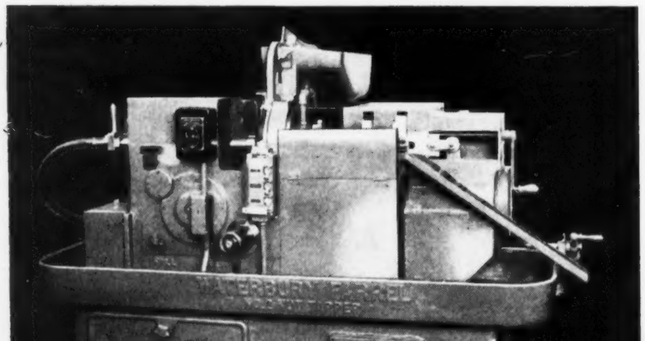


Fig. 1. Waterbury-Farrel Improved Automatic Straight-tap Nut-tapping Machine

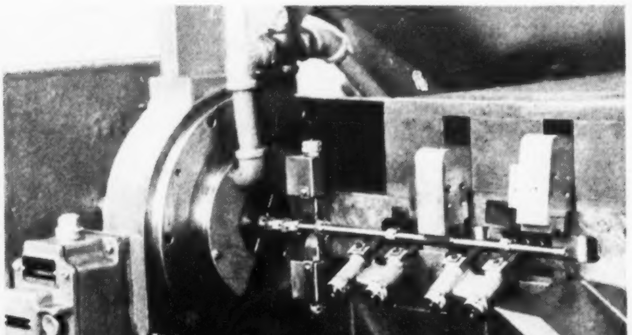
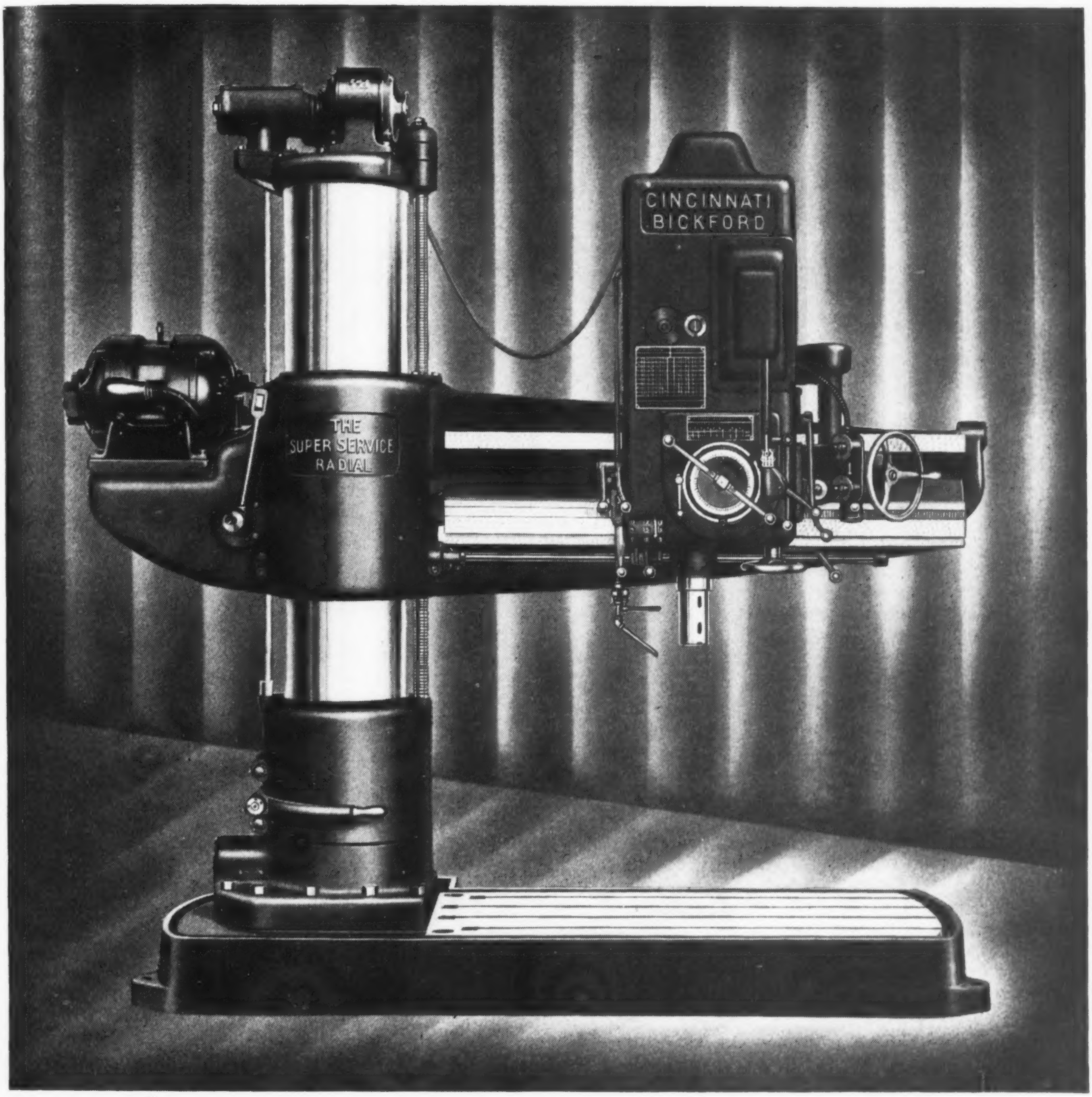


Fig. 2. Close-up View of Straight-tap, Tap-holding and Nut-stripping Mechanism

To obtain additional information on equipment described on this page, see lower part of page 176.



SPEED *and* DEPENDABILITY

are required on all fronts of a truly all-out effort for victory. Production lines must keep pace with front lines. Our front line can only stay ahead of the enemy with the best of men and equipment. Likewise, production must keep ahead of schedules with the most efficient men and equipment.

For your drilling department the Super Service Radials are available in sizes from 3' to 8' arms and the Super Service Uprights in 21", 24" and 28" sizes.

ARMY E NAVY
AWARDED SEPT 10, 1942

THE CINCINNATI BICKFORD TOOL CO.

OAKLEY · CINCINNATI · OHIO · U. S. A.

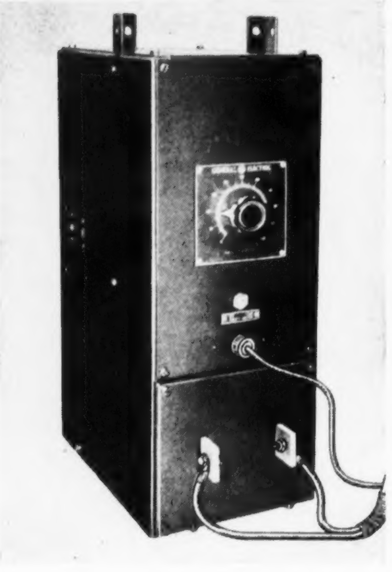


Fig. 2. Electronic Half-cycle Spot-welding Control Made by the General Electric Co.

tions for which a control of this type is designed. It provides the very high currents and short welding time required for the satisfactory resistance-welding of aluminum, which has low resistance and high heat conductivity.

The control consists of a charging circuit, a discharge circuit, control station, Pyranol capacitors, and sequence control. All this equipment is mounted in one cabinet type enclosure with full length front doors and removable rear covers. The enclosure is ventilated by filtered air which, drawn in by a blower, creates a positive pressure within the cabinet, thus minimizing the infiltration of dust and dirt that would harm the mechanism.

The electronic half-cycle synchronous control shown in Fig. 2, designed for the precise operation of resistance welding machines, is another new product of the company. This control is mounted in a protecting cabinet, and is furnished in two types. The CR7503-A136 type includes a welding transformer and is designed for bench mounting, while the CR7503-A133 type, without a transformer, is designed for wall mounting. Both types can be used either with tongs or with a suitable bench welder. Heat adjustment is accomplished by a dial mounted on the cabinet.

The control facilitates the welding of tinned copper, steel, or alloy wires or studs from 0.01 to 0.05 inch in diameter to flat surfaces with little or no indentation on the opposite surface of the metal. It is also adapted for spot-welding thin pieces—less than 0.01 inch thick—of stainless or mild steel, and nickel or silver to brass or bronze, with negligible oxidation or discoloration. The control also makes possible the welding of low-resistance joints which are unaffected by temperatures considerably in excess of 125 degrees C. 66

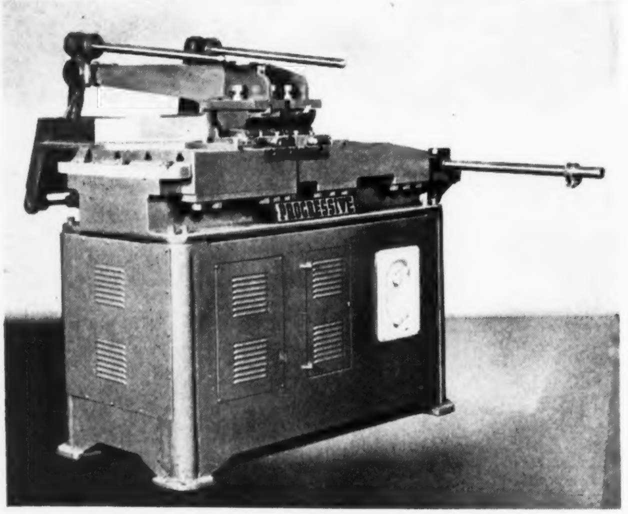
Flash Welders with "Flash-Trol" Monitors

The first of a new series of flash welders has been announced by the Progressive Welder Co., Detroit, Mich. An outstanding feature of this new Model C flash welder, rated at 150 K.V.A., is a "Flash-Trol" monitor, which provides an automatic weld-quality control by eliminating short-circuiting of the flash-welding arc. The device is designed to make possible a higher than normal rate of acceleration of the feed platen while performing the weld, thus automatically insuring the maximum welding speed without the danger of incomplete welds or line overloads due to short-circuiting. Upsetting speed and pressure are furnished by a single air-hydraulic booster, which forces oil in the proper quantity at high speed into the traversing cylinder. 67

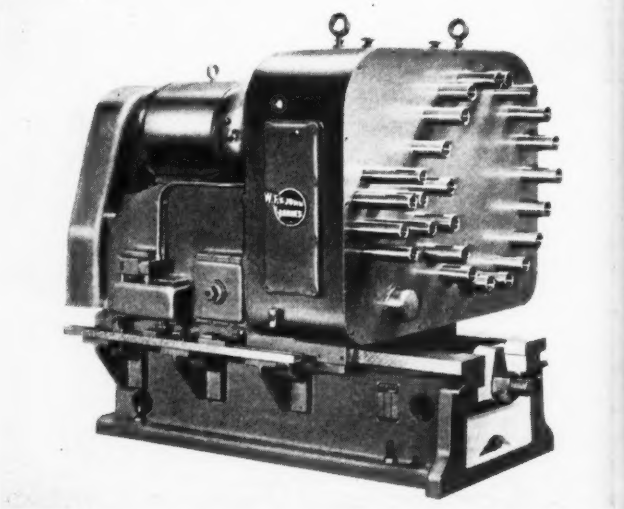
Hydraulically Actuated Units for Drilling Revolving Turrets for Tanks

The W. F. & John Barnes Co., Rockford, Ill., has equipped two of its standard drilling units with special multi-spindle heads for drilling operations on 360-degree revolving turrets for M-4 medium tanks.

One unit has twenty-five spindles, and the other twenty-four spindles. The machine with the twenty-four-spindle head, shown in the accompanying illustration, has eighteen spindles equally spaced about a circle and six spindles in a cluster. Both heads are equipped with anti-friction bearings, hardened alloy steel gears, and heat-treated spindles and shafts. 68



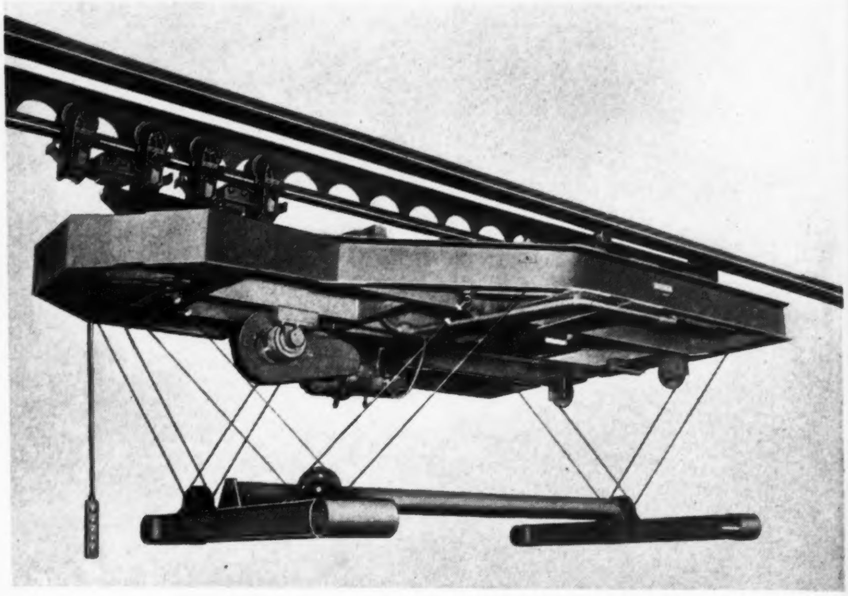
Flash Welder with Automatic Quality Control, Brought out by the Progressive Welder Co.



W. F. & John Barnes Hydraulically Actuated Unit for Drilling 360-degree Revolving Tank Turret

To obtain additional information on equipment described on this page, see lower part of page 176.

Cleveland Stabilized Tramrail Carrier



Cleveland Stabilized Tramrail Carrier

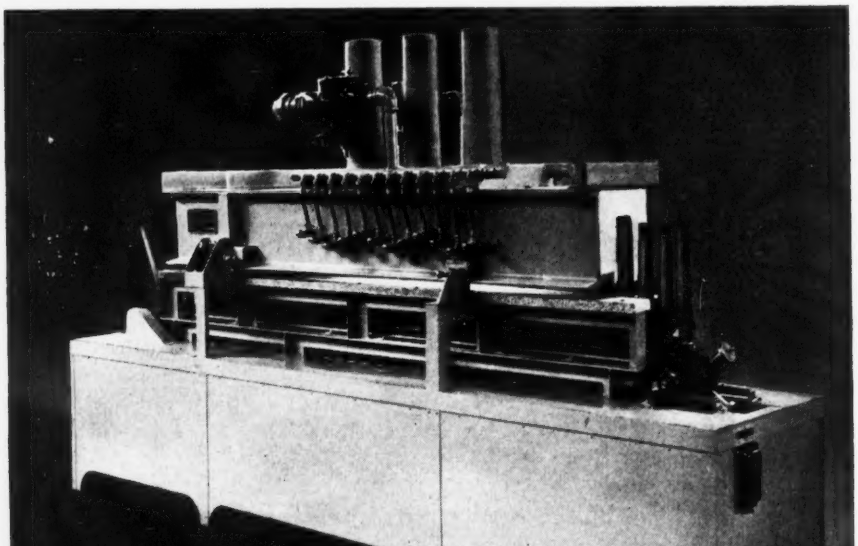
The Cleveland Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio, has brought out a new stabilized tramrail carrier designed to solve the problem of suspending a hoisted load rigidly by the use of the usual flexible hoisting ropes. By a simple patented arrangement of the ropes that form a triangular suspension, a load can be held rigidly in place, so as to eliminate longitudinal, lateral, and rotational sway.

A load can be raised or lowered through a considerable distance with nothing more than the hoisting ropes supporting it, yet it will remain as rigid as if guided in an elevator shaft. Even if the load should be unbalanced, the carrier will hold it rigidly in place. For example, when used to convey airplanes several men can sit on the extremity of one of the wings without disturbing or unbalancing the load. The carrier also permits the load to be tilted in either direction with relation to the rail on which the carrier travels. If it is desirable to rotate the load, this can be done with a trunnion type load bar.

The carrier can be operated on two standard Cleveland tramrails or on a double-girder tramrail crane bridge. It also can be operated on a regular type overhead Cleveland tramrail, on each side of which are parallel flat rails or I-beams for supporting the stabilizing rollers attached to the carrier. These stabilized carriers are built in capacities of 1, 3, and 5 tons, some of the hand-propelled and some of the electrically propelled types. All have the motor-driven hoist. 69

Selas Machine for Mouth-End Annealing of Steel Cartridge Cases

For continuous annealing of the mouth ends of steel cartridge cases in sizes from 37 to 105 millimeters, the Selas Co., Philadelphia, Pa., has recently designed and built a series of automatic machines utilizing ceramic-cup radiant gas burners in refractory-lined tunnels. The tunnels are let down over moving lines of cartridge cases, as shown in the illustration. Each cartridge case rotates about fifteen times on an individual spindle during its transit through the annealing tunnel, so that uniform preheating, heating, and cooling are achieved over the desired area. In the unit shown, which handles 37- and 40-millimeter cartridge cases, the tunnel is lowered sufficiently to anneal the metal down to a point several inches below the mouth opening.

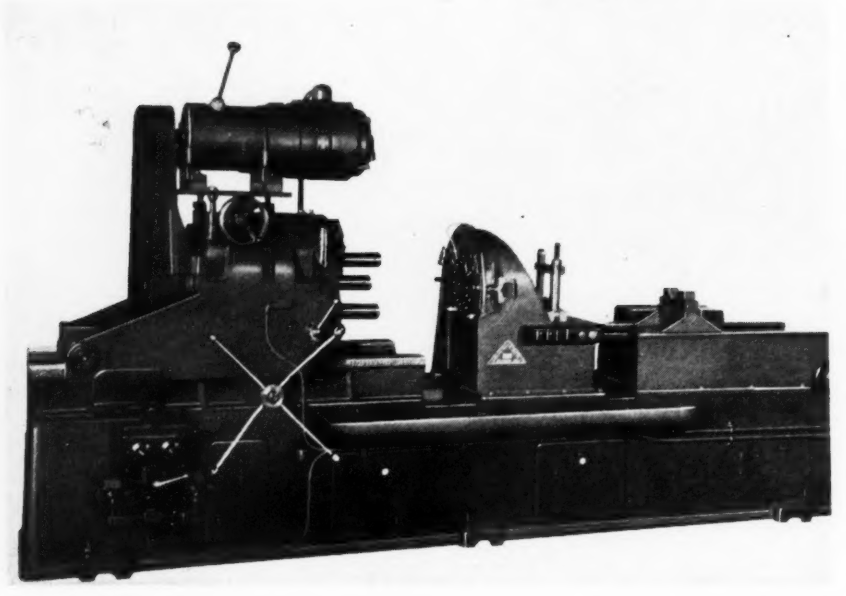


Selas Heat-treating Machine Arranged for Annealing Mouth Ends of Steel Cartridge Cases

Because combustion is confined within the ceramic concavity of each burner, the flame does not directly impinge upon the work.

The twenty-four burners are staggered (twelve in a zig-zag pattern on each side of the tunnel), and each burner has a built-in needle-valve input adjustment. Thus, heat inputs at various points can be independently adjusted and balanced to suit the work.

To obtain additional information on equipment described on this page, see lower part of page 176.



LeMaire Crankshaft Drilling, Reaming, and Tapping Machine

Consumption of fuel in the model shown amounts to 750 cubic feet per hour of natural gas, or 1400 cubic feet per hour of manufactured gas. The primer-cup end of each cartridge case remains cool because of the speed and localization of heating over the portion annealed, the corrugated asbestos heat baffle immediately below the tunnel, and the contact of the primer-cup end with the cold metal mass of the spindle it rests upon.

The annealing tunnel is quickly removable by lifting; it is supported on jack-screws and positioned by longitudinal and transverse adjusting screws which allow for expansion. The tunnel is lined with 4 1/2 inches of insulating refractory material. The conveyor mechanism is adjustable for speed, is hand-loaded, and is driven by a 1/2-H.P. motor. It utilizes self-aligning ball bearings and pillow blocks with take-up adjustment. The floor space required for the machine is 2 1/2 by 11 feet. 70

Crankshaft Flange Drilling, Reaming, and Tapping Machine

A machine for drilling, reaming, and tapping holes in the flanges of crankshafts has been developed by the LeMaire Tool & Mfg. Co., Dearborn, Mich., especially for manufacturers whose total volume of shafts produced, although large, is made up of several different models requiring many short runs of various set-ups. This machine is designed as a compromise between the single-spindle set-up and one having fixed-spindle drill heads. Individual fixtures are employed for crankshafts of different types or models.

Three horizontal spindles, spaced 120 degrees apart around a circle, can be adjusted to any bolt circle diameter from 5 1/2 to 10 inches. By indexing the head in which these spindles are mounted, it is possible to drill flanges having three, six, or twelve holes. The movement of the spindle head is controlled by a hydraulic circuit for drilling and reaming, provision being made for rapid advance, coarse feed, fine feed, and rapid return. For tapping, the hydraulic cylinder is disconnected and the taps fed into the work by manual operation of the star-handles.

The four-speed transmission provides for drilling and tapping at efficient speeds. All three operations of drilling, reaming, and tapping can be performed at one setting. The spindles are driven through a cluster box with universal joint connections to the gears. The whole spindle drive is carried in a drum rotated by a worm and worm-wheel and provided with an index-plate and locking bolt. The right-hand end of the machine is equipped with a fixture having removable adapters, V-blocks, and drill plates, which can be set up to accommodate crankshafts of various models. 71

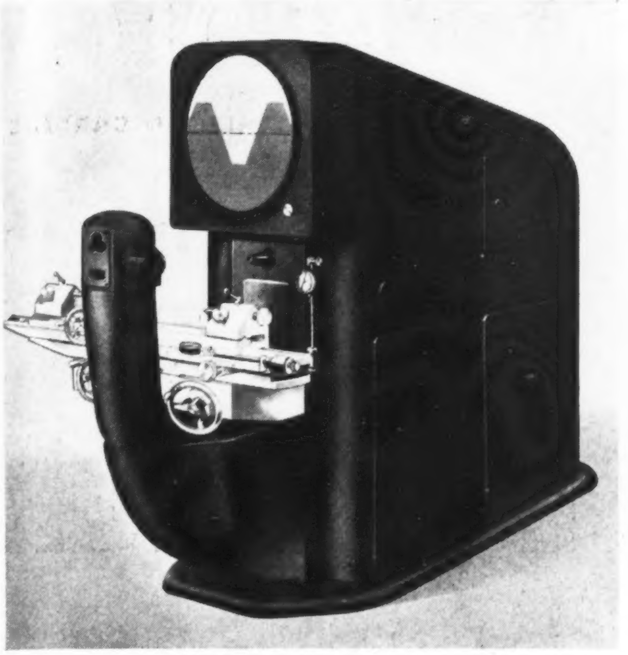
Anderson Hydraulic Hand Press

A high-speed straightening press designed to eliminate the necessity for moving the shaft being straightened from the anvils to centers for checking has been brought out by the Anderson Bros. Mfg. Co., 1907 Kishwaukee St., Rockford, Ill. Thus, bending and checking are accomplished with the work in the same position. When the pressure is released, the spring tension, acting on rolls, frees the shaft allowing it to rotate freely for checking.

The checking rolls are easily adjusted for different lengths of shafts, and can be removed altogether if necessary. The press is equipped with an indicator gage, calibrated in thousandths of an inch, for locating high and low spots on the shaft. It is also equipped with a pressure gage calibrated in pounds. The exact tonnage required to straighten any shaft can be quickly determined by the operator. This machine is now built to handle work up to 1 1/2 inches in diameter. The hand-operated hydraulic pump provides pressures up to 20,000 pounds. 72

Anderson Straightening Press

To obtain additional information on equipment described on this page, see lower part of page 176.



Portman Optical Comparator with Universal Stage

Wilberton Floor Type Surface-angle Plate

Portman Universal Optical Comparator

The Portman Machine Tool Co., 17-19 Beechwood Ave., Mount Vernon, N. Y., is manufacturing a Model P-3 universal optical comparator designed to cover a wide range of work and provide an unusually large mechanical working capacity.

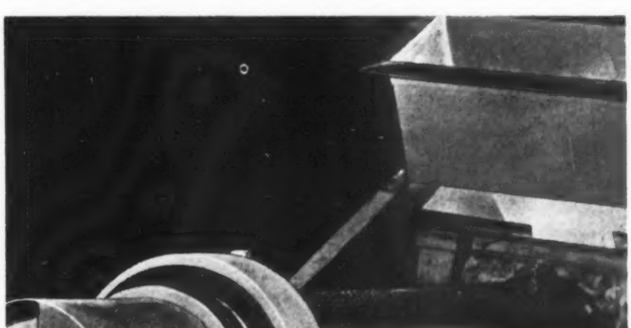
Lens units are available which provide for six different magnifications ranging from 10X to 100X. Special lens units having higher magnifications can also be furnished. The universal type stage enables the operator to place work in various positions, offers flexibility of movement in all directions, and permits precise readings to 0.0001 inch over the entire range.

The distance between the work-holding centers is 12 1/2 inches. Both vertical and horizontal measuring ranges are 8 inches. The work screen is 18 inches in diameter and permits vernier reading to 360 degrees. The work-table is 6 by 24 inches. Provision is made for setting the stage to an angle of 22 degrees. The machine weighs 1500 pounds. 73

Combination Master Surface-Angle Plates

Thomas Wilberton & Co., Cedar Grove, N. J., has brought out floor and bench models of a combination surface plate and angle plate designed to facilitate a wide variety of inspection operations on production work. Elongated slots in the angle plate, as shown in the illustration, enable the use of draw-studs for holding the work under inspection, thus eliminating C-clamps. Work to be inspected or laid out weighing as much as 5000 pounds can be held in position without undue strain on the angle or surface plates of the floor model.

The floor model has an angle plate 18 by 19 inches and a surface plate 24 by 36 inches. It weighs 2300 pounds. The bench model has a surface plate 14 by 18 inches, and weighs 145 pounds. 74



"Spiralveyor" Developed by the Salem Engineering Co.

"Spiralveyor" for Removing Heat-Treated Parts from Quenching Tank

The Salem Engineering Co., Salem, Ohio, has recently developed a machine designated the "Spiralveyor" for the rapid removal of heat-treated parts from a quenching tank. Small stampings or forgings which leave the discharge end of a furnace and enter the quench are removed from the quenching tank by the "Spiralveyor," which also conveys them to a pickling unit at the rate of 8000 pounds per hour.

The unit has an inclined perforated steel tube 18 inches in diameter through which a spiral conveyor screw operates. The screw carries the parts up through the tube and out of the

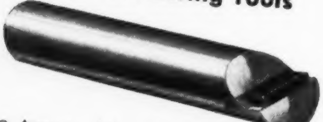
To obtain additional information on equipment described on this page, see lower part of page 176.

Over 300 CARBOLOY STANDARDS*

*Standard Stock TOOLS AND BLANKS

Standard stock items are tools and blanks manufactured in mass production and are therefore lower in price and more readily available than tools or blanks made only upon receipt of order. Large number of items are now in this standard stock classification. Of particular importance to war plants are the standard tools shown below at right. To meet rush needs, many plants keep active stocks of these and quickly grind special shapes as needed.

Precision Boring Tools

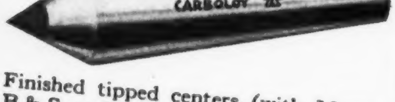


Two types: (1) carbide tipped (with flat top or back rake) sizes $\frac{5}{16}''$ through $\frac{1}{2}''$ dia. (2) solid carbide $\frac{3}{32}''$ through $\frac{1}{4}''$ dia.

Lathe and Grinder Centers

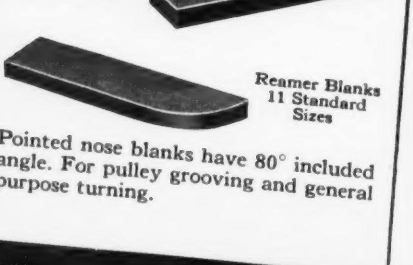
(Up to 50 times longer life than steel.)

Carbide tips only.

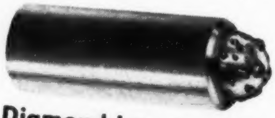


Finished tipped centers (with Morse, B & S, and Jarno Tapers).

Special-Purpose Standard Stock Carboloy Cemented Carbide Blanks



Pointed nose blanks have 80° included angle. For pulley grooving and general purpose turning.



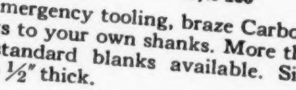
Masonry Drills

Drills concrete, brick, etc. 75% faster than old methods. Use in portable electric drills or hand braces. Speeds up installation of wiring, piping, machinery, etc. Sizes $\frac{3}{16}$ to $1\frac{1}{2}$.

Diamond-Impregnated Grinding Wheel Dressers

Contains large number of sharp diamond particles permanently embedded in carbide matrix. Eliminates remountings. Saves 25% in annual dresser costs. 3 sizes. For all grinding wheels.

General-Purpose Standard Carboloy Blanks



Style 100 | Style 200

For emergency tooling, braze Carboloy blanks to your own shanks. More than 100 standard blanks available. Sizes $\frac{1}{16}''$ to $\frac{1}{2}''$ thick.

Ammunition Dies

(Catalog D-113-R)

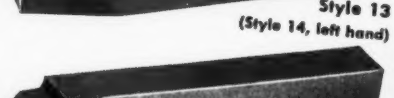
.30 and .50 cal. drawing dies

For drawing steel shell 20 thru 105 mm. Complete line of brass shell dies.

Standard Turning, Boring, Facing Tools for Steel, Cast Iron, Etc.

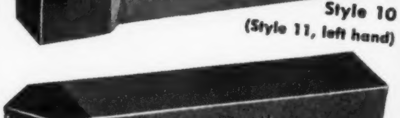
(You can grind to hundreds of special shapes. Wide range of sizes.)

Style 4
(Style 7, left hand)



Style 13
(Style 14, left hand)

Style 5
(Style 9, left hand)



Style 10
(Style 11, left hand)

Style 12

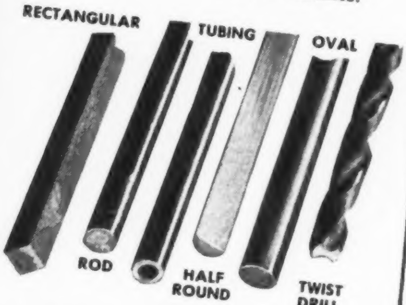
Style 1

*Standard Design TOOLS AND BLANKS

Standardized design items, in general, are former special tool styles for which there previously has been a large demand within a narrow range of minor design variations. Standard designs for these have been established to broadly meet most previous requirements. You can now order these items simply by tool number and eliminate considerable time for drafting, blueprints, quotations, detailed ordering, etc.

Extruded Shapes for Rod Tubing and Twist Drills

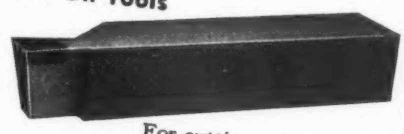
This unusual Carboloy Company development provides economical production of many unique shapes for wear resistant uses. Standards now available in lengths up to 30" in shapes shown. Specials where quantity warrants.



6 Films Available for Your Plant Training Program

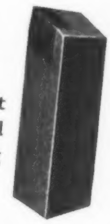
Films show detailed step-by-step procedure on manufacture, design, application and maintenance of carbide tools. 35 mm. silent slide films (not motion pictures) available at approximate print cost of $20 per set.

Cut-Off Tools



For cutting off to hollow cores such as shell forgings, etc.

Tools for Roller Turners ("Box" Tools)



For W & S and Gisholt lathes. Extra large tips and special shapes provide long period of tool life.

Grooving Tools

Available in widths over .060" through .330" Tolerances up to .0004".

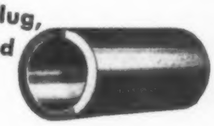
Shear Type Tools

Heavy duty tools in 4 sizes for interrupted cuts on large forgings and castings.

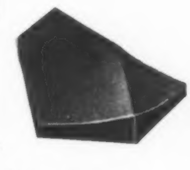
Solid Carbide Guide Rings

For wear resistant uses on machines such as wire stranding machines. Increases life up to 50 times.

Bushings for Plug, Ring Gages and Drill Jigs



Twist Drill Carbide Blanks



Standardized in 30 sizes from 1/8" to 1 5/8" diameter.

Also Selected Types of Special Tools—such as gun drills, form tools, grooving tools, skiving tools, etc.

Send for Free Catalog

32-page catalog GT-142 contains prices and specifications of all standard stock and standard design Carboloy Cemented Carbide tools. Also lists 76 tool manufacturers supplying special Carboloy-tipped cutters, gages, etc. Write for your copy today.

Meeting Carbide Demands 45 Times Greater Than Pre-War Years

CARBOLOY

quenching tank. Since the wall of the tube is perforated with 9/32-inch holes, all the water drains away from the parts, permitting them to enter the pickling bath without diluting it. 75

Machine Tool Sump-Tank Cleaning Machine

A machine designed for thoroughly cleaning sump tanks of machine tools, especially grinding machines, of all sludge, chips, coolant, or old oil at a rapid rate, has been developed by the W. R. Carnes Co., Madison, Wis. Whereas the old "dip-and-bail" method of cleaning frequently required an hour's time, the new machine will do this work in ten minutes.

A patented construction feature prevents excessive wear or clogging of the pump, as none of the pumped liquid actually passes through the pump proper. A basket separates solids, chips, and sludge from the liquid. The equipment is easily moved from machine to machine. It is built in sizes suitable for any sump-cleaning operations. 76

Anderson "Roto-Checker"

Anderson Bros. Mfg. Co., 1907 Kishwaukee St., Rockford, Ill., has developed a new piece of equipment designated the "Roto-Checker" for speedily checking the straightness of shafting, tubing, or pieces having the same diameter at both ends.

The work can be mounted directly on the disks, which rotate in ball bearings. In addition to checking the straightness of shafts and similar work, this "Roto-Checker" can also be employed for balancing operations, since its spindles and bearings are the same as those used in the standard balancing equipment made by this company.

The "Roto-Checker" is made up of a rugged, ribbed cast-iron base, precision-scraped, and is equipped with a dial test indicator. It is now regularly supplied in a size suitable for handling work 36 inches long, but larger sizes can be made to suit requirements. 77

"Fuse-Bond" Process for Metallizing Hardened Surfaces

The Metallizing Engineering Co., Inc., 21-07 Forty-first Ave., Long Island City, N. Y., has announced the development of a "Fuse-Bond" process and equipment for its application whereby machined components and similar metal parts can now be prepared for metallizing electrically. The main advantage of the process is that it affords an adequate bond on the hardest surfaces, heretofore considered impossible or impracticable to obtain by sandblasting. It is also said to simplify the preparation of narrow edges, flat areas, and cylindrical parts having keyways and other irregularities.

In the application of this process, the Metco "Fuse-Bond" unit, operating on any 110- or 220-volt, single-phase power line, fuses a rough deposit of electrode metal into the

Metco Fuse-Bond Unit

surface to be metallized. Electrodes are applied to the work with a special holder which uses up to six electrodes at a time, depending on the size and nature of the work. Small parts can be prepared with this equipment as easily as large shafts, since there is no excessive heating of the base metal or disturbing of its physical properties.

The "Fuse-Bond" unit is contained in a cabinet only 24 inches high, and weighs but 170 pounds. The unit is mounted on casters and can be easily wheeled to the job. 78

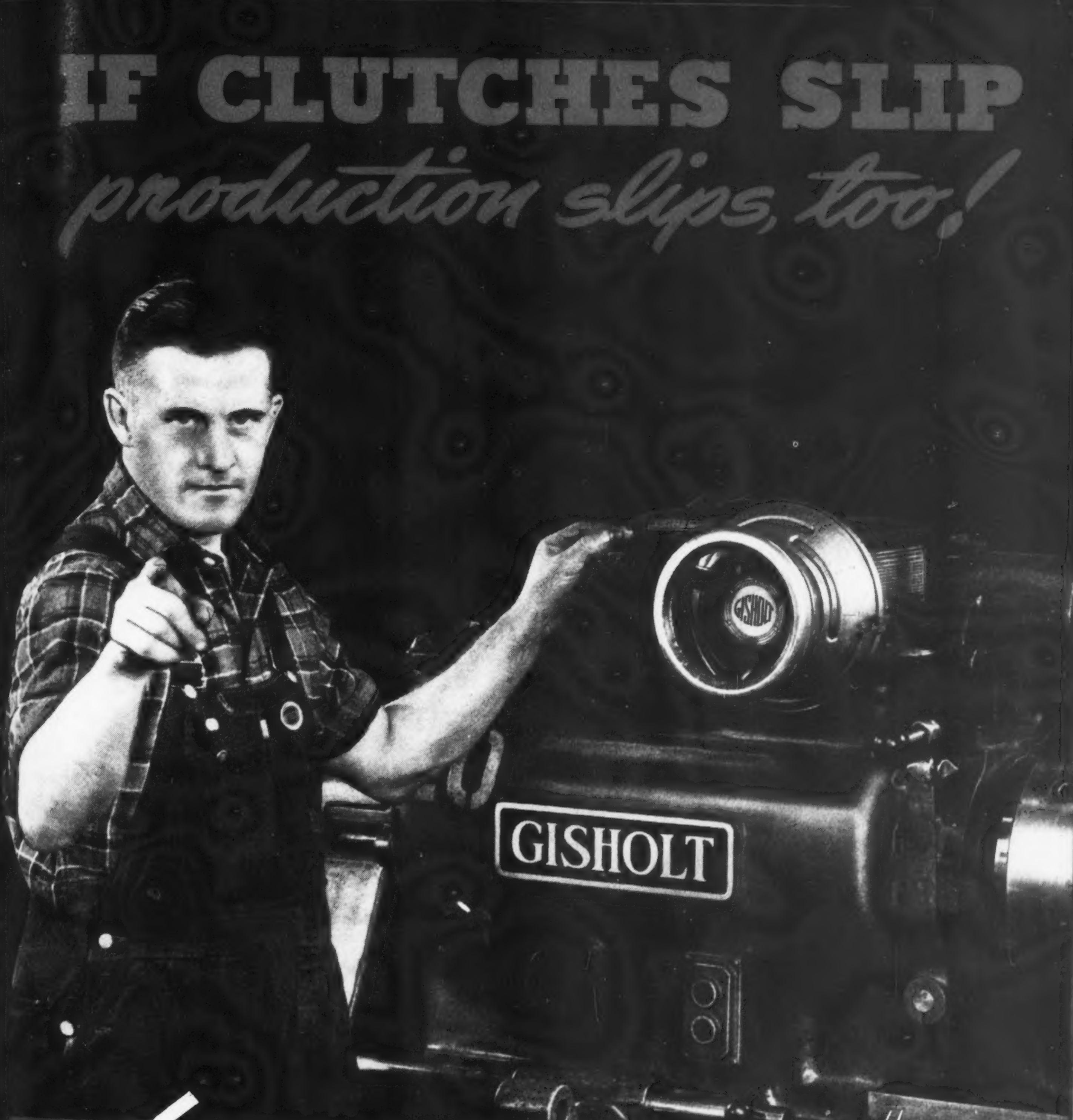
Multiple-Operator Welding Machines

A new type of low-voltage electric current supplying equipment for multiple-operator welding operations is being manufactured by the Hanson-Van Winkle-Munning Co., Matawan, N. J. This equipment is designed especially for use in shipyards to enable a large group of welders to work from one motor-generator set.

This multiple-operator welder with one motor-generator set will supply current for a number of operators, since at no time will all operators use their joint machine simultaneously. It reduces the floor space required, helps maintain uniformity and quality of welding, and provides a dependable, easily controlled current. It has a capacity of 1500 amperes at 70 volts, and is made in two types—stationary and semi-portable. In the stationary type, the drive motor can be supplied in either alternating-

Anderson "Roto-checker" for Testing Straightness of Shafts

To obtain additional information on equipment described on this page, see lower part of page 176.



★ *Reprints of this page are available for bulletin board use in your turret lathe department. Write the Gisholt Machine Company, 1209 East Washington Avenue, Madison, Wisconsin. Ask for "War Time Care and Operation Poster No. 2." State quantity desired.*

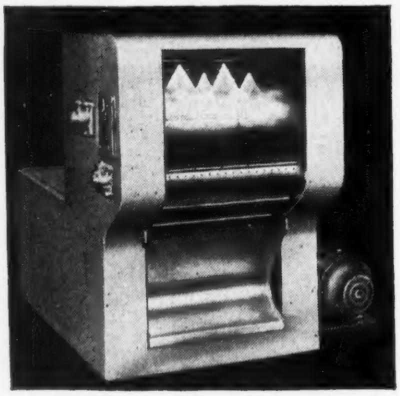
or direct-current type. The semi-portable type comprises a complete drive and control mounted on a single bedplate. This completely wired unit is easily accessible. 79

"Tumbl-Spray" Metal-Washing Machine

A machine for washing small metal parts, designed around a special patented endless tumbling belt, is a recent development of the American Foundry Equipment Co., 555 S. Byrkit St., Mishawaka, Ind. This batch type machine, known as the "Tumbl-Spray," receives and discharges the parts to be cleaned through a large opening at the front. It is similar in action to the rotary-drum type cleaning machine in that the work is tumbled to expose all surfaces to the cleaning action of the sprays.

The patented open type barrel gives complete access to the parts while in process, and the spray system is readily accessible for cleaning and inspection of the pipes and nozzles. The machine is especially suited for cleaning small screw machine products that can withstand a slight tumbling action. Where the parts are handled in batch form, the wash can be followed by a fresh water rinse, permitting the rinsing water to drain to a sewer, in order to prevent contamination of the washing solution, when this is desirable.

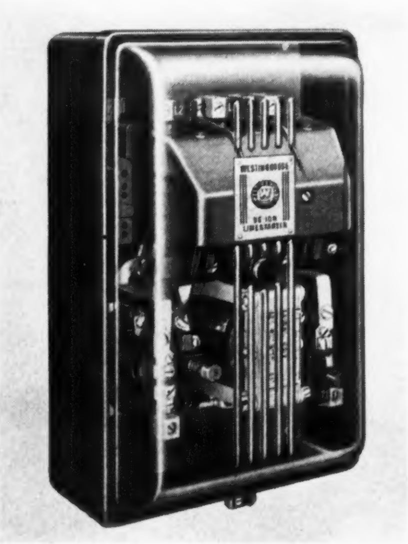
Another lay-out provides a power wash and a power rinse, followed by a compressed air drying action for the removal of excess liquid. A special arrangement keeps the two solutions separate and permits washing and rinsing in one compartment without transferring the parts. To unload, the machine is run in reverse, causing the parts to be discharged over a chute. This unit is available for heating with steam, gas, or electricity, and can be supplied with full-automatic control. 80



"Tumbl-Spray" Metal-washing Machine Manufactured by the American Foundry Equipment Co.

Westinghouse "Linestarter"

A new Size 2, Class 11-200 "Linestarter" for machine tools, textile machinery, pumps, fans, and similar machines, which requires less than half the mounting space of former units, has been brought out by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This starter is designed for group mounting, built-in applications, or remote mounting, and has a new clapper type armature with knife-edge bearings. It utilizes double-break silver-to-silver contacts, thus eliminating shunts and reducing maintenance cost.



"Linestarter" Brought out by the Westinghouse Electric & Mfg. Co.

Overload relays are reset either by hand or automatically. On applications requiring sequence or auxiliary interlocking, provision is made for a total of four normally open or closed electrical interlocks. All parts are accessible from the front of all control circuit terminals, and interlock terminals are clearly marked to facilitate installation and repair. 81

Atlas Weld-cleaning Tool

Weld-Cleaning Tool

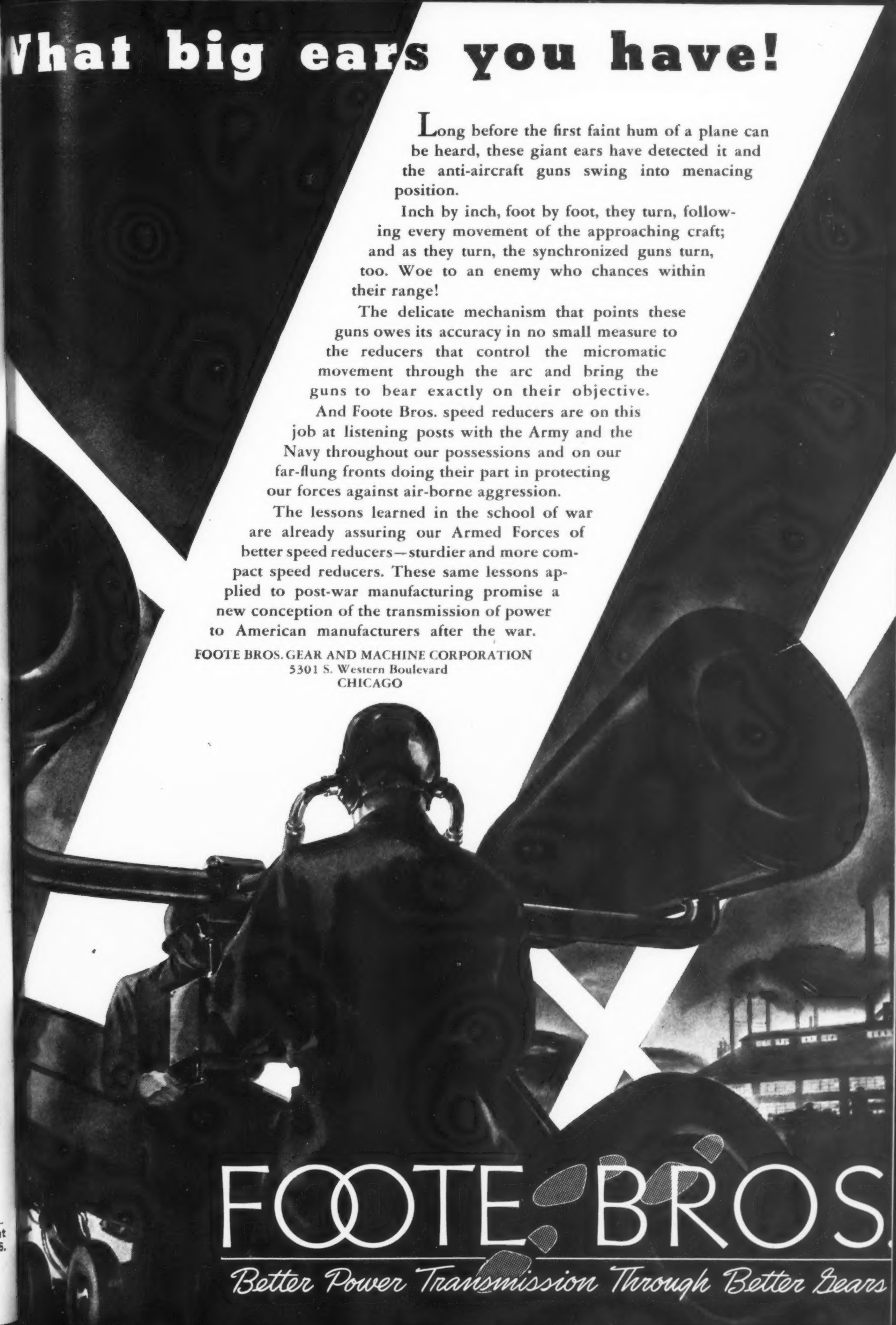
An improved weld-cleaning tool for workers in shipyards, aircraft and tank plants, and boiler and sheet-metal shops is now being manufactured under the trade name "Dual-Tool" by the Atlas Welding Accessories Co., 307 Boulevard Bldg., Detroit, Mich. This tool has a wire bristle brush, a slag-removing bit, and a specially designed brush-holder which permits removal of the brush for reversing or replacement by means of a screw-driver or other sharp object applied at the rear of the holder. Each part of the tool is replaceable, including the cone and chisel bits. 82

"Dia-Tool" Metal-Bonded Diamond Wheels

A line of metal-bonded diamond cup-wheels designed for off-hand grinding and lapping of cemented carbide and for grinding and edging quartz and glass has been introduced on the market by Dia-Tool, Inc., 320 Yonkers Ave., Yon-

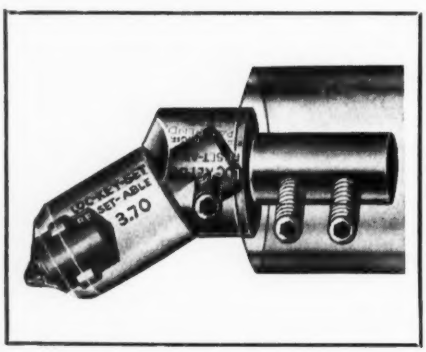
Special "Dia-Tool" Grinding Wheel with Diamond Abrasive Positioned to Suit Work

To obtain additional information on equipment described on this page, see lower part of page 176.


What big ears you have!
Long before the first faint hum of a plane can be heard, these giant ears have detected it and the anti-aircraft guns swing into menacing position.
Inch by inch, foot by foot, they turn, following every movement of the approaching craft; and as they turn, the synchronized guns turn, too. Woe to an enemy who chances within their range!
The delicate mechanism that points these guns owes its accuracy in no small measure to the reducers that control the micromatic movement through the arc and bring the guns to bear exactly on their objective.
And Foote Bros. speed reducers are on this job at listening posts with the Army and the Navy throughout our possessions and on our far-flung fronts doing their part in protecting our forces against air-borne aggression.
The lessons learned in the school of war are already assuring our Armed Forces of better speed reducers—sturdier and more compact speed reducers. These same lessons applied to post-war manufacturing promise a new conception of the transmission of power to American manufacturers after the war.
FOOTE BROS. GEAR AND MACHINE CORPORATION
5301 S. Western Boulevard
CHICAGO
FOOTE BROS.
Better Power Transmission Through Better Gears

kers, N. Y. An outstanding feature of these wheels is their extreme density of diamond concentration, the diamond particles being practically in contact with each other. This feature results in a very fast grinding action, with little effort and increased wheel life through decreased load per diamond particle. The depth of the diamond section is 1/32 inch.

A very strong and tough metallic matrix that keeps the diamond particles in place until they are completely worn tends to give these wheels a longer life and better resistance to rough treatment. An important advantage of the wheel design is its reinforced outside edge. The metallic matrix, including the diamonds, is drawn over the side or periphery of the wheel. The wheels are available in grit sizes from 80 to 400, and can be made with the diamond abrasive located on the brass cup-wheel bodies to suit the customer's needs. 83

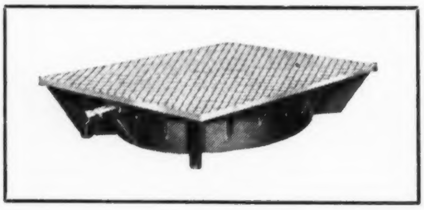


Holder for Grinding Wheel-dressing Diamond Made by Diamond Tool Co.

Improved Angle-Set Tool for Diamond Dressers

The Diamond Tool Co., 930 E. 41st St., Chicago, Ill., has added to its line of diamond tools, turning and boring form tools, etc., a new 30-degree angle-set attachment for dressing wheels for the centerless grinding of bullet noses. This attachment employs 3 to 4 karat common-quality diamonds, permitting improved finish.

The mean fixed position, left or right, in which the diamond nib is held prevents wear of the setting in this dressing operation. An important feature of this dresser is that it permits rotation of the nib, as required, for presenting a sharp edge to the wheel. 84



Smith Lapping Plate

Smith Precision Lapping Plate

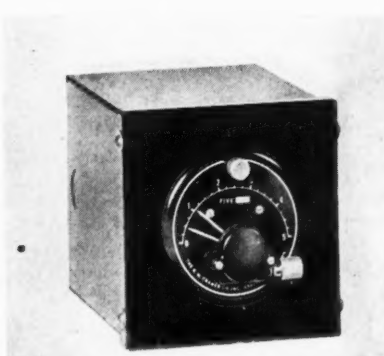
Precision lapping plates specifically designed to develop a true plane of close tolerance, thus insuring a perfect fit when lapping metal-to-metal joints or accurate flat-lapped surfaces, have been placed on the market by the Smith Tool & Engineering Co., 808 N. Sandusky Ave., Bucyrus, Ohio. These lapping plates have elliptical rib construction similar to the Master surface plates made by this company.

The accuracy of these precision lapping plates is checked with the three-plate system. All plates are precision-lapped to a final flat surface and grooved at an angle, the angle of the grooves crossing each other in such a manner as to form diamond-shaped flat areas. The plates are made in standard sizes ranging from 8 by 12 inches to 48 by 120 inches. 85

Cramer Reset Timers

The RS4 and RS5 synchronous motor-driven timers of the reset type, just put on the market by the R. W. Cramer Co., Inc., Centerbrook, Conn., are available for time ranges up to five hours, and even longer if desired. These timers have a wide application for accurately timing any electric circuits, such as the automatic timing of machining operations, chemical and heating processes, etc. They repeat their time cycle by the manual operation of a built-in starting button, and show at a glance by means of a progress indicator that moves toward the zero mark of the scale, the expired and unexpired time cycle, as well as the setting time.

These timers will control a 1/3-H.P. motor load, a heater load up to 1200 watts, a lamp load up to 250 watts, or a relay load that does not exceed 15 amperes at 115 volts alternating current. 86



Cramer Motor-driven Reset Timer

Thermaload Motor Starter Brought out by the Monitor Controller Co.

Solenoid Motor Starter

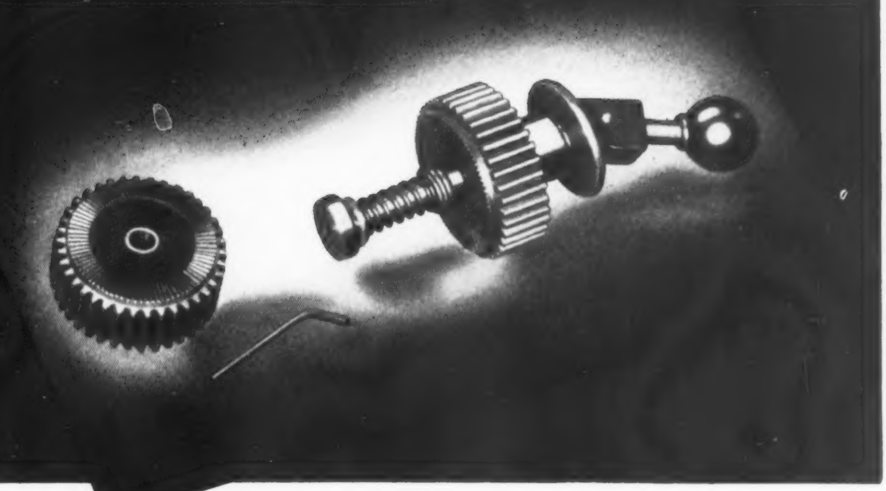
The Monitor Controller Co., Baltimore, Md., has recently brought out a Thermaload V solenoid motor starter having features previously found only on large controls. Its small size permits installation in small spaces. The Thermaload V bimetal compensated overload relay permits efficient starter operation under extreme changes of temperature. Full overload protection is assured because the trip always occurs within the same time at a given percentage of overload.

A further safeguard for the motor is a unique arrangement that prevents the operator from holding the starter button on the "On" position, thus preventing the trip from operating when overload occurs. The operator must press the button and release it before contact is made. This starter has been tested and approved by the Underwriters Laboratory, and is available in five

To obtain additional information on equipment described on this page, see lower part of page 176.

QUICK ENGAGEMENT

GREATER PULLING STRENGTH

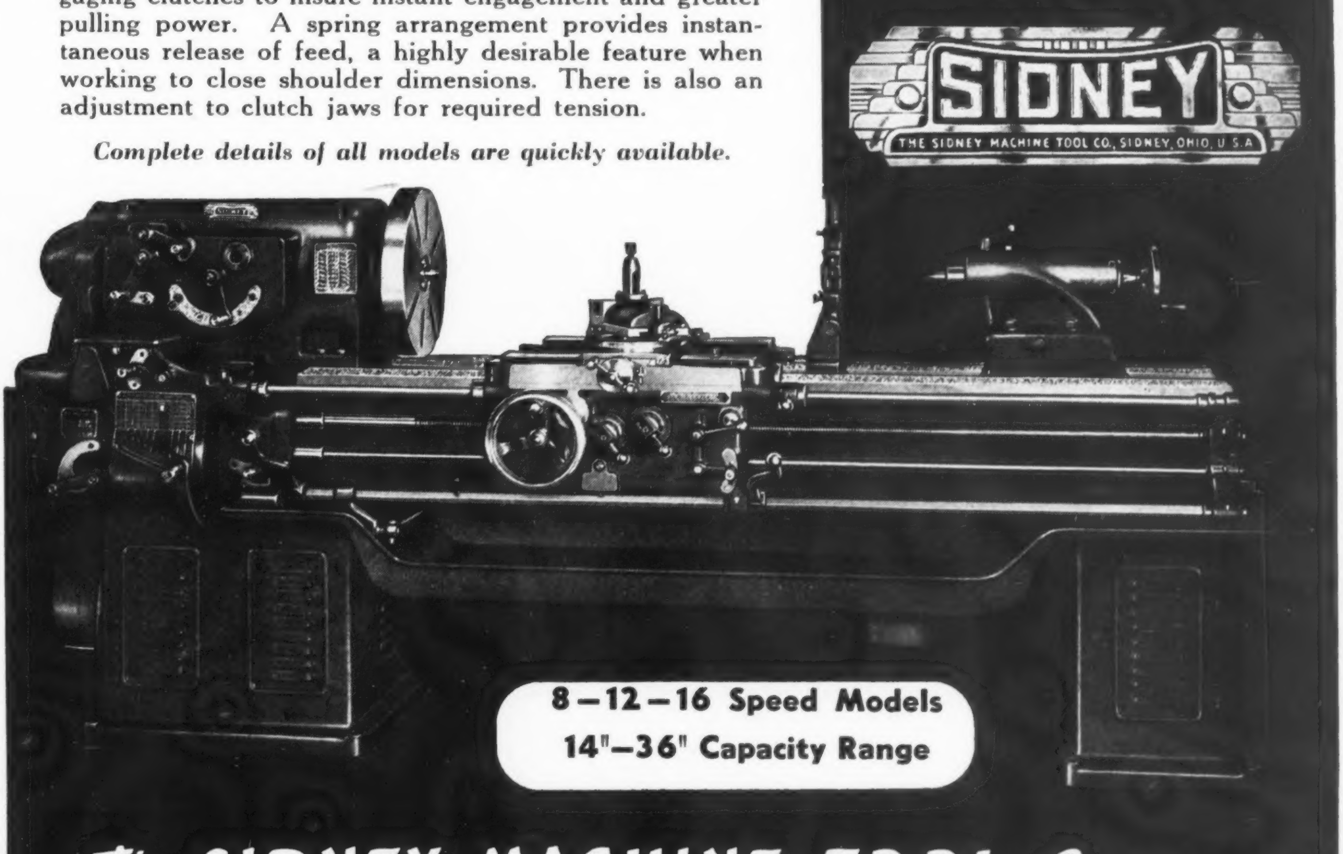


feature APRON-CLUTCHES ON *Sidney Lathes*

Every unit contributing to the Speed and Power of Sidney Lathes is helping to step-up our War production to a point heretofore considered impossible.

The Apron Clutch illustrated is one of the advanced mechanical units incorporated in the design of Sidney Lathes. The serrated teeth are cut on entire face of engaging clutches to insure instant engagement and greater pulling power. A spring arrangement provides instantaneous release of feed, a highly desirable feature when working to close shoulder dimensions. There is also an adjustment to clutch jaws for required tension.

Complete details of all models are quickly available.



8—12—16 Speed Models
14"—36" Capacity Range

The SIDNEY MACHINE TOOL *Company*

Builders of Precision Machinery

SIDNEY — ESTABLISHED 1904 — OHIO

sizes ranging from 1.5 to 7.5 H.P. and 110 to 550 volts alternating current. 87

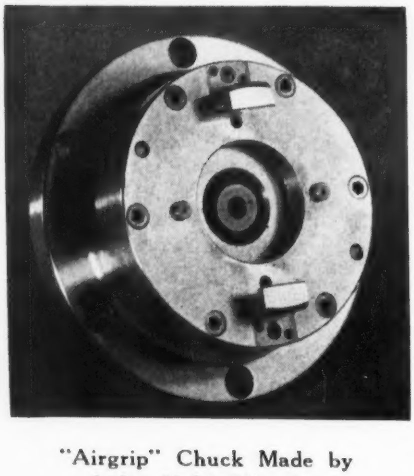
Heavy-Duty Soluble Cutting Oil

The Standard Oil Co. of Indiana, 910 S. Michigan Ave., Chicago, Ill., has developed a heavy-duty soluble oil that will help speed war production and reduce costs by simultaneously providing the required cooling effect, finish on the work, and tool life. The new product is stable in storage, mixes easily, does not gum machines or work, possesses good anti-rust properties, is non-injurious to the workmen's hands, and has no tendency to develop objectionable odors. 88

"Airgrip" Chuck

Compensating type finger chucks have been added to the line of "Airgrip" holding devices made by the Anker-Holth Mfg. Co., 332 S. Michigan Ave., Chicago, Ill. Special features of these new air-operated finger chucks include an arrangement that permits one finger to pull in farther than the other, thereby compensating for varying thicknesses of the work; means for locating pieces from a fixed center stop position; and provision for performing second-operation work to extremely close tolerances.

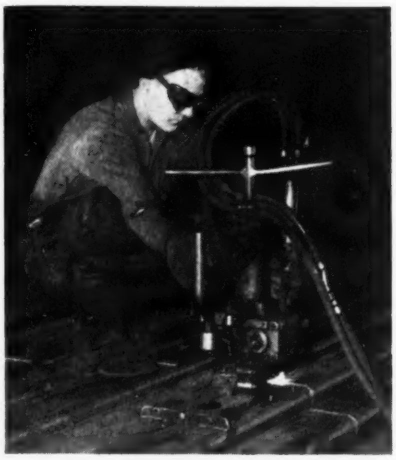
The piece is driven by two fixed driving pins, and is held against the chuck face by the two compensating fingers. The chuck body is flanged and drilled for direct mounting on the spindle nose. The range of finger travel can be made to suit requirements. These chucks are available in a range of sizes designed to be operated by Anker-Holth high-speed revolving air cylinders, which are made in sizes from 3 to 18 inches. 89



"Airgrip" Chuck Made by Anker-Holth Mfg. Co.

Bar-Cutting Oxy-Acetylene Machine

Portable oxy-acetylene bar-cutting machines, brought out by The Linde Air Products Company, 30 E. 42nd St., New York City, are being used in various mills for such operations as squaring the ends of rolled bars, removing etch-test specimens, cutting bars to lengths for shipment from the mill and for individual forgings.

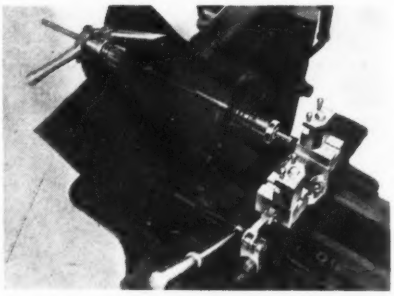


Oxy-acetylene Machine Used for Cutting Billets to Shipping Lengths and to Square Ends

The machine requires neither electric power nor track on which to operate, being positioned directly on the material to be cut, as shown in the accompanying illustration, both for cutting round and square bars. The cutting blowpipe is automatically guided along the contour of the bar by means of a swinging mechanism, which is actuated by a self-contained hydraulic power unit. 90

Collet and Cross-Slide Attachments for Lathes

Two new accessories that are claimed to convert most small and medium-sized engine lathes into the speed range of hand production screw machines have been announced to the trade by Kessler Aero Products Co., 211 W. Palm Ave., Burbank, Calif. The Aero quick-acting collet-closing attachment is designed for use in performing accurate duplicate work on bar and tubing stock from 1/32 inch up to and including 1/2 inch in diameter. It permits chucking and releasing work while the lathe is running.



Lathe Equipped with Kessler Collet and Cross-slide Attachments

The Aero lever type cross-slide used in conjunction with the collet closer provides for forming and fast cut-off operations. Both attachments are recommended for use on Atlas, Craftsman, South Bend, Logan, and similar lathes of 3/4-inch spindle capacity. 91

"Metex" Coolant Strainer for Machine Tools

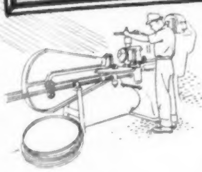
The Metal Textile Corporation, Orange, N. J., has added to its general-purpose line of "Metex" coolant strainers two super-capacity types known as Models G and H. Model G, for grinders, has an unusually high capacity, obtained by a combination of three filter elements, held side by side. The filter units can be quickly replaced by simply removing thumb-nuts.

The essential function of the new "Metex" Model G filter is to prevent chips or particles from being recirculated in the coolant, and thus prevent scoring of the work. When installed in the sump tank ahead of the circulating pump, the strainer offers the additional advantage of keeping the pump free from chips. Installation is simple, requiring the connection of only one pipe.

The capacities of the Model G strainers range from 15 to 60 gallons per minute, while those of the single-unit Model H strainers are 5 to 20 gallons per minute. 92

To obtain additional information on equipment described on this page, see lower part of page 176.

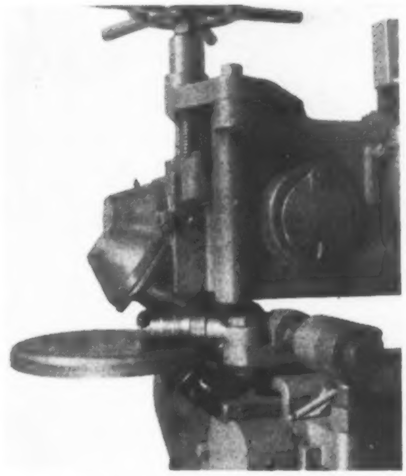
Don't Wait for a New Machine! Use Your QUICKWORK for Flanging Operations



If you own a Quickwork Rotary Shear, whatever its original purpose, you can quickly put it to work flanging any type of sheet within the range of its capacity. For general work or straight production, your Quickwork-Whiting Shear with flanging attachment flanges circular sheets in a wide range of sizes and flange depths. Uniformity of the work and high speed operation are assured.

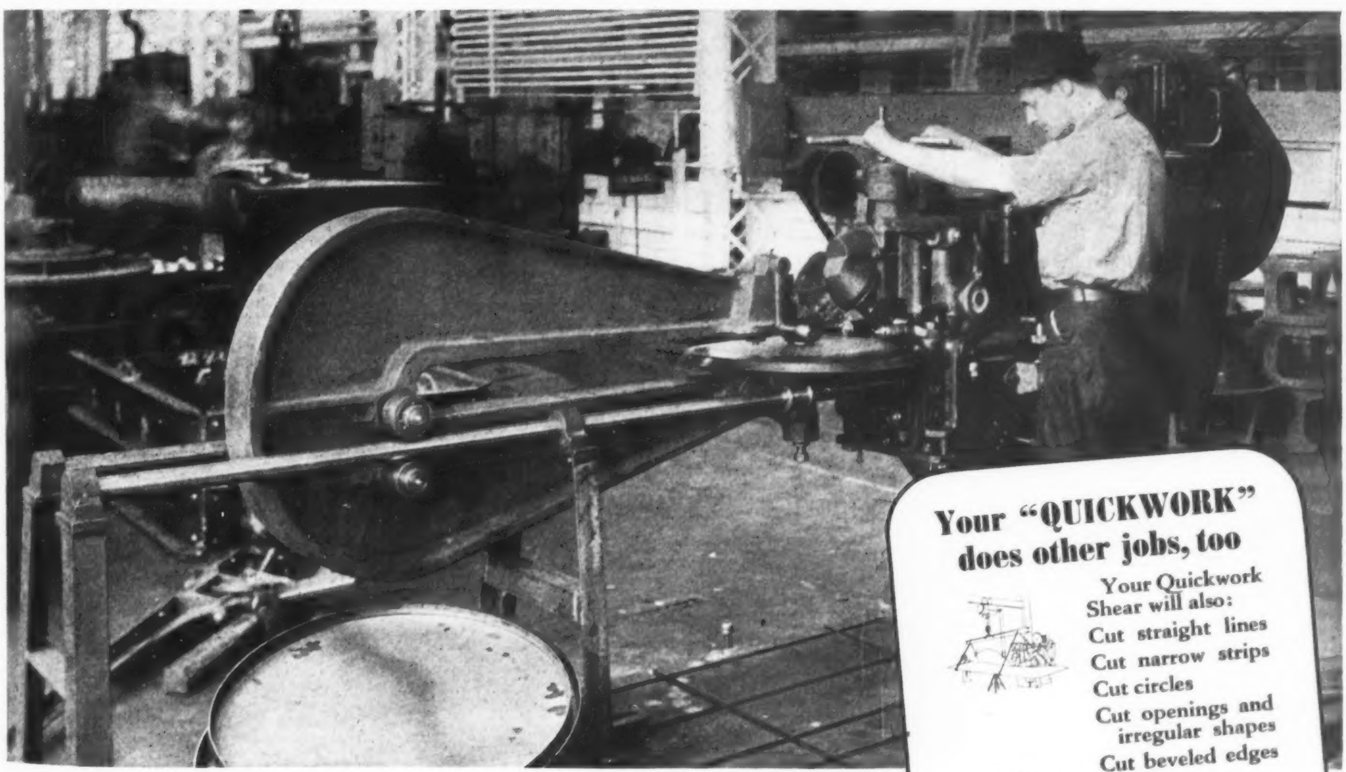
Save delay—investigate the Flanging Attachment and the other special attachments that make your Quickwork-Whiting Rotary Shear the most versatile tool in any shop.

Write for your copy of the Quickwork-Whiting Bulletin on Special Auxiliary Attachments for Quickwork Rotary Shears.



Above: Close-up of flanging operation showing special attachment in position.

Below: Forming flange on a No. 25A Quickwork shear with circle-cutting attachment in position. Stack of finished flanged heads.



Your "QUICKWORK" does other jobs, too

Your Quickwork Shear will also:
- Cut straight lines
- Cut narrow strips
- Cut circles
- Cut openings and irregular shapes
- Cut beveled edges
- Joggle
- Make clean cuts without burrs—in a single pass at high speeds.

Don't wait for a new machine. Use your Quickwork.

"QUICKWORK" WHITING

***Division of* Whiting Corporation, 15673 Lathrop Ave., Harvey, Illinois**

Automatic Machines for Operations on Tank Turret Rings

Special machines with automatic indexing tables and equipment for drilling, reaming, counterboring, and tapping accurately spaced holes in work up to 91 inches in diameter have been built recently by Baker Brothers, Inc., Toledo, Ohio, for three large tank producers. Although these machines, arranged as shown in the accompanying illustrations, were built especially for operations on the main turret rings of tanks, they are adaptable to other kinds of work requiring similar operations.

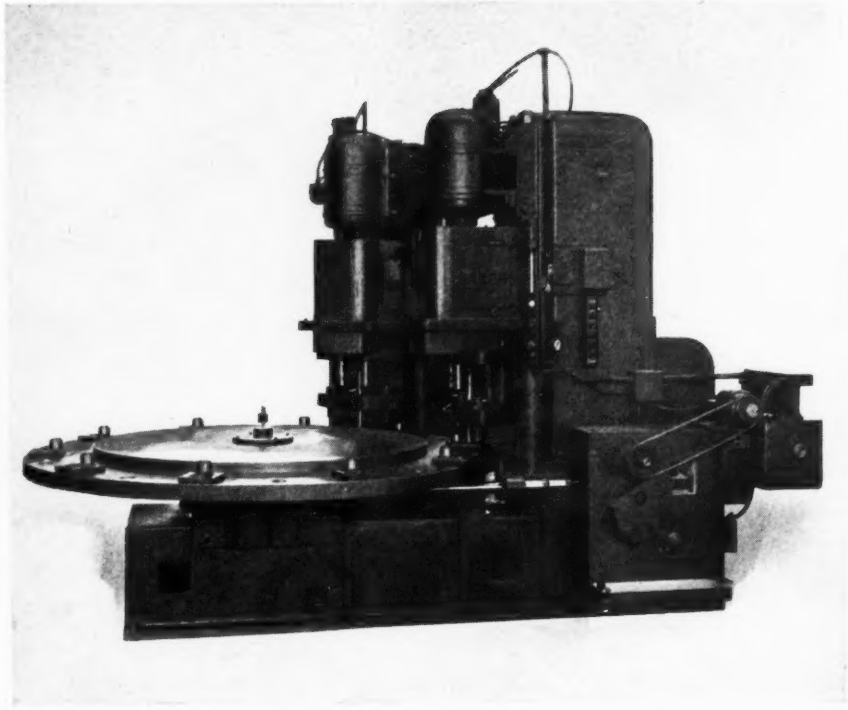


Fig. 1. Special Machine Built by Baker Brothers, Inc., for Automatically Drilling Forty Holes in Turret Ring for Tanks

The machine shown in Fig. 1 consists essentially of two Baker 26-HO hydraulic feed units with multiple heads mounted on special bases around a power-driven automatic indexing table. A single 26-HO hydraulic feed unit mounted on a special base with work-table carrier comprises the machine shown in Fig. 2. A 26-HO machine with multiple head for drilling and chamfering operations and an automatic tapping unit is shown in Fig. 3.

The machine shown in Fig. 1 drills and countersinks forty holes in a turret ring, while the one shown in Fig. 2 counterbores forty-eight holes. Each of the two spindles in the multiple head of the latter machine counterbores a 1.250-inch hole, twenty-four indexing movements of 15 degrees being required to counterbore the forty-eight holes. The third machine, shown in Fig. 3, has an eight-spindle multiple head and a four-spindle tapping unit. The tapping unit is arranged with individual lead-screw to each spindle, and is driven by a reversing motor. This machine automatically drills, countersinks, and taps forty-eight holes in a ring that is later assembled with the one handled on the machines shown in Figs. 1 and 2.

Each machine is entirely automatic in operation, including the machining and indexing cycles. It is only necessary for the operator to chuck the ring from the proper locating points, clamp it in place, and press the starting button. The machine then automatically performs all operations, electrical control and interlocking of the various units with the power automatic in-

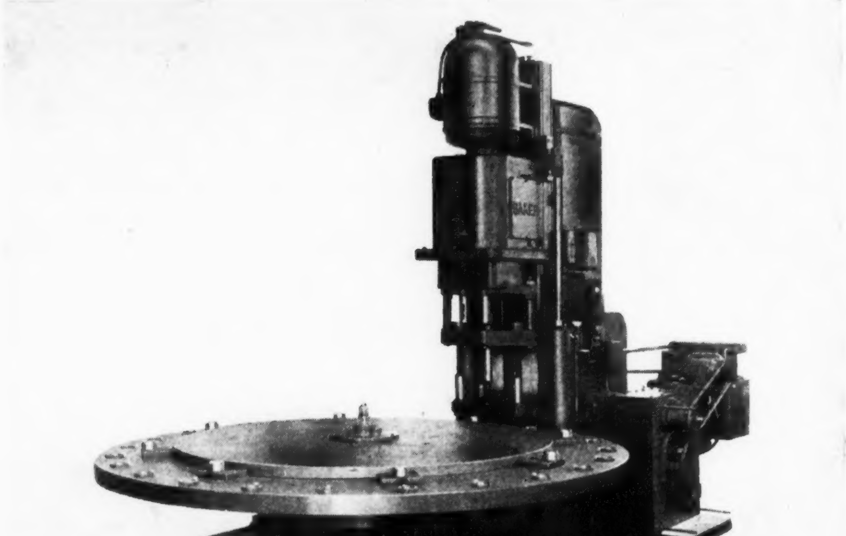


Fig. 2. Baker Two-spindle Multiple-head Machine with Power Indexing Table and Work-holding Fixture Plate for Counterboring Holes in Turret Ring

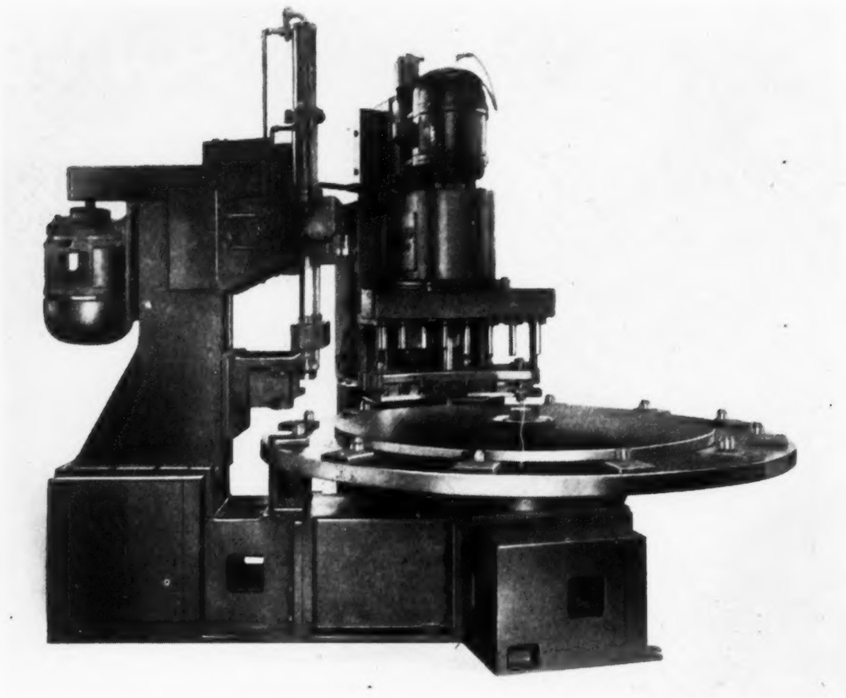


Fig. 3. Special Two-unit Baker Brothers Machine Equipped with Eight-spindle Multiple Head and Four-spindle Tapping Unit for Automatically Drilling, Chamfering, and Tapping Forty-eight Holes in Turret Rings for Tanks

dexing table being provided to insure proper functioning.

The table can be arranged to index for different numbers of accurately spaced holes; but since it is indexed about a fixed center, the diameter of the drilling circle must remain the same. The tools are held in the multiple head and supported by bushings on the machine head.

Recovery of Paint from Industrial Spray Booths

With the cooperation of the Chicago Section of the American Chemical Society, the Industrial Salvage Branch of the War Production Board recently presented an exhibit at the National Chemical Exposition in Chicago, showing methods of recovery of paint "overspray." The exhibit comprised a small water-wash spray booth, a mixer of a type used by paint manufacturers in reclaiming collected overspray, and a display of samples and panels of original and reclaimed paint.

A great many products that now come off the war industries' assembly lines are painted by spray-painting processes. This is where a considerable amount of waste of paint occurs through what is known as "overspray." It is estimated that about 30 per cent of the paint used in the spray process can be recovered by methods that have already been tested. Aside from representing substantial savings of critical materials, an effective program of reclamation would mean great savings in the cost of painting of war equipment.

S. Donald Perlman, chief of Chemical Resources Section of the Industrial Salvage Branch of the War Production Board, states that satisfactory methods of reclaiming the collected overspray have been developed and that information on the methods can be obtained from any of the larger paint companies. Information can also be obtained from the Promotion Unit of the Industrial Salvage Branch, 1100 H St., N.W., Washington, D. C.

Salvaging High-Speed Steel Tools

The Buick Motor Division of General Motors has a salvage plan that saves an appreciable amount of high-speed steel. In cases where a high-speed steel turning tool has been used until it is too short for further use, a piece 2 or 3 inches long is generally left. This blank is sent to the central tool salvage department, where it is held until a quantity of the same size has accumulated. The high-speed steel scrap is then sent to the tool-room, where it is forged to a size smaller in cross-sectional area, but obviously longer, so that it can be used in machines where smaller tools are required. By this method, no high-speed steel tools are scrapped until the tool is too small to be forged into another tool. Great savings have been accomplished by this method. The only requirement for success is that the forge shop must know how to forge high-speed steel without checking or seaming.

* * *

New Army-Navy "E" Production Awards

The latest additions to the list of companies in the machinery and allied fields honored by the award of the Army-Navy "E" for excellence in war production are as follows:

American Hammered Piston Ring Division, Koppers Co., Baltimore, Md.

Cleereman Machine Tool Co., Green Bay, Wis.

Cincinnati Milling and Grinding Machines, Inc., Cincinnati, Ohio.

Cleveland Automatic Machine Co., Cleveland, Ohio.

Delta Mfg. Co., Milwaukee, Wis.

Hyatt Bearings Division, General Motors Corporation, Harrison, N. J.

Mathews Conveyer Co., Ellwood City, Pa.

Unitcast Corporation, Toledo, O.

* * *

How much tin is actually saved through the turning in of old toothpaste tubes? Figures show that last October these old tubes yielded 80 tons of tin.

NEWS OF THE INDUSTRY

California

Fray Machine Tool Co., Glendale, Calif., manufacturer of milling machines and other precision shop equipment, announces its incorporation for $1,000,000. J. H. Richards has been appointed president and general manager; O. W. Weyman, vice-president; and Dr. Lock Hale, secretary and treasurer. The new corporation, formerly a partnership, retains all patents, equipment, and good will formerly held by Mr. Richards, and will be known as the Fray Machine Tool Co., Inc.

Marinship Corporation, Sausalito, Calif., has been presented with the Maritime Commission's "M" award of merit for its outstanding contribution to ship construction.

Illinois

Albert H. Eggers, vice-president and machine tool sales manager of Greenlee Bros. & Co., Rockford, Ill., has been made president of the company to succeed George C. Purdy, who becomes chairman of the board. Mr. Eggers joined the Greenlee organization in 1915, when it began manufacturing metal-working machinery. Leslie H. Geddes, assistant sales manager in charge of screw machine sales, has been made second vice-president of the company. O. Vincent Haegg succeeds Albert E. Alverson as secretary. Mr. Alverson has retired after forty-two years of service with the company.

Standard Oil Co. of Indiana, Chicago, Ill., announces that it will present gold service pins to 668 employes during the first six months of this year, representing a total of 12,160 years of service. Six employes will be awarded pins for forty years of service each, sixty-eight employes for thirty years, and the remainder for twenty and ten years. The thirty-year employes who will be honored include F. H. Fillingham, assistant general sales manager in charge of the Eastern Division, and W. T. Bannister, division manager at Minneapolis, Minn.

Charles A. Crane has rejoined Templeton, Kenly & Co., Chicago, Ill., manufacturers of lever, screw, and hydraulic jacks. Mr. Crane will serve as assistant to the president. Many years ago he left Templeton, Kenly & Co. for the construction field, in which work he gained intimate engineering experience that will be of value to jack users in construction work. He will devote part of his time to developing new types of jacks.

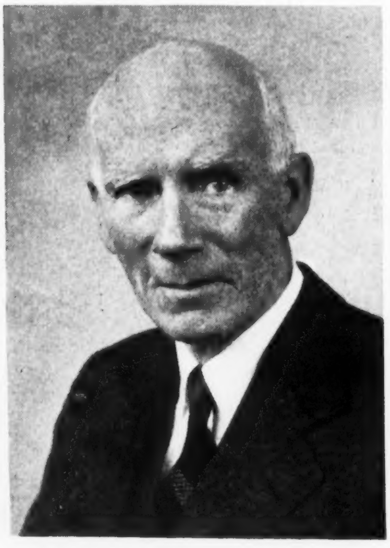
James R. Hewitt has been appointed vice-president of the American Manganese Steel Division of the American Brake Shoe & Foundry Co., Chicago Heights, Ill.

Michigan

Holly M. Olson has been made chief mechanical engineer of the Sealed Power Corporation, Muskegon, Mich., manufacturer of pistons and piston-rings. Vern H. Bathrick becomes assistant chief mechanical engineer. The duties of Mr. Olson and Mr. Bathrick cover all divisions of the company. Before his connection with this company, Mr. Olson was assistant chief mechanical engineer of the Muskegon plant of Continental Motors Corporation, and for the last few years has served as chief mechanical engineer of the Piston-Ring Division of the Sealed Power Corporation.

Detroit Rex Products Co., 13005 Hillview Ave., Detroit, Mich., manufacturer of degreasers and metal washing equipment, announces the establishment of two new offices. One of these, serving the north central region, is in Detroit, and covers the state of Michigan, with the exception of the upper peninsular; the other, serving the south central region, covers the states of Ohio, Indiana, and Kentucky, and is located at Dayton, Ohio. R. W. Pflug is in charge of the Detroit office, and W. F. Newbery of the Dayton office.

Brace H. Sibley has been appointed factory manager of the Champion Spark Plug Co., Detroit, Mich.; B. O. Black has been placed in charge of production planning and control; J. A. Soden has been made assistant to the factory manager; John Nolan becomes production engineer; and J. H. Beatty has been made supervisor of employe relations. The retirement due to ill health of C. E. Dewar, formerly vice-president in charge of pro-



George C. Purdy, Chairman of the Board of Greenlee Bros. & Co.

Albert H. Eggers, Recently Elected President of Greenlee Bros. & Co.

Leslie H. Geddes, Second Vice-president of Greenlee Bros. & Co.

IN TIMES LIKE THESE
the best hydraulic oil
IS THE ONLY GOOD ONE'

HYDRO-DRIVE MIH

In these days of 24-hour production, more and more men are examining with great care the types of oils which must be relied upon to give them longest trouble-free service.

If your hydraulic oils do not provide smooth operation, true indexing, with lack of jerkiness, you need a treated oil which has greater oxidation stability, greater strength, greater solvent ability.

Houghton's HYDRO-DRIVE Oils have these three outstanding properties, being specially fortified by modern scientific treatment of the best selected stocks.

HYDRO-DRIVE Hydraulic Oils provide a tough lubricating film three times stronger than possessed by the same oils untreated. Their stability means that they resist pressures, heat, moisture and agitation. Their solvent ability prevents deposition of gum and sludge for greatly extended periods.

Compare HYDRO-DRIVE MIH against other oils. Permit our technical men to take drainings at regular intervals, without interrupting production. The reports you will obtain will convince you of the advantages to be obtained from changing to Houghton's "fortified" hydraulic oils.

Write for the HYDRO-DRIVE Booklet, prices and service details

E. F. HOUGHTON & CO.

PHILADELPHIA • Chicago • Detroit • San Francisco

duction, who has served the company for twenty-eight years, is also announced.

A. F. Dobbrodt has been appointed southern district manager for the Carboloy Company, Inc., Detroit, Mich., with headquarters at 1719 Comer Bldg., Birmingham, Ala. He has been connected with the company since 1929, previously having had charge of the design, sales, and servicing of Carboloy cemented-carbide tools in the Chicago, Milwaukee, Rochester, and Cleveland areas. His new territory will include Tennessee, Florida, Mississippi, Alabama, Texas, Georgia, and Louisiana.

Walter Moehlenpah has been appointed field welding engineer for the Progressive Welder Co., East Outer Drive, Detroit, Mich., covering Missouri, southern Illinois, western Indiana, southeast Kansas, southeast Nebraska, and southwest Iowa. Mr. Moehlenpah joined the company two years ago, and has been in charge of marketing the Frostrode refrigerating units used in connection with resistance welding equipment.

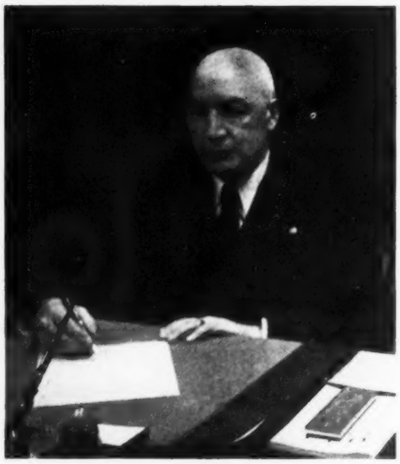
Carhoff Co., 3050 Kensington Road, Cleveland, Ohio, manufacturer of eye drops for the relief of eye burns caused by welding flashes, announces the appointment of the Boyer-Campbell Co., 6540 Antoine St., Detroit, Mich., as distributor for the company.

Ralph E. Kramer has been appointed general manager of the Suprex Gage Co., Ferndale, Mich. Previous to his present connection, he was president of the H. Channon Co., Chicago, Ill., distributor of industrial supplies, tools, and machinery.

American Engineering Co., Philadelphia, Pa., manufacturer of Hele-Shaw fluid power pumps, has appointed the American Equipment Co., 5928 Second Blvd., Detroit, Mich., representative of the company in the state of Michigan.

New England

Captain Nelson W. Pickering, USNR, was ordered to report for active duty on February 1, and accordingly, has resigned as president of the Farrel-Birmingham Co., Inc., Ansonia, Conn. He has been assigned to duty as Commander of the U. S. Navy Section Base at New London and Commander of local defense forces in that area. Before becoming connected with the Farrel-Birmingham Co. in 1919, Captain Pickering had served for fifteen years in the Navy. He was graduated from the United States Naval Academy in 1908, and was assigned to duty overseas in the first World



Captain Nelson W. Pickering, Who has Resigned as President of Farrel-Birmingham Co., to Return to Active Duty in the United States Navy

War in connection with ordnance matters pertaining to heavy gun construction and liaison work with the naval railway batteries in France. In 1919, he resigned from the Navy and started work in the roll department of the Farrel Foundry & Machine Co., becoming successively assistant manager and manager of that department. In February, 1930, he was elected president of the Farrel-Birmingham Co., with executive direction of the company's three plants at Ansonia and Derby, Conn., and Buffalo, N. Y. During his business career in Ansonia, he took an active interest in the industrial and civic life of the community. At the same time, he maintained his interest in the naval service, and was Naval Aide to Governor Trumbull and Governor Baldwin, of Connecticut. A testimonial dinner was given him by his civic and business associates at the Hotel Clark in Derby, Conn., on January 25, at which time he was presented with a silver tray.

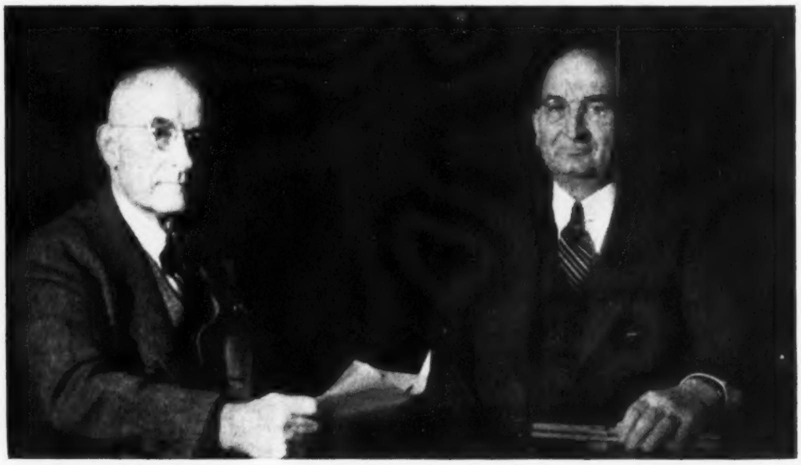
A. F. Murray has joined the staff of the Electrolux Corporation, Forest Ave., Old Greenwich, Conn., in the capacity of works manager. Mr. Murray was previously connected for over twenty years with the Westinghouse Electric & Mfg. Co. He will have complete charge of the manufacturing operations for the corporation, which is now devoted to the production of essential war materials.

Robert A. Hurley, former Governor of Connecticut, has joined the Narragansett Machine Co., Pawtucket, R. I., as vice-president and member of the board of directors. This company is engaged in the manufacture of arms, equipment, precision tools, and parts for the armed forces of the United States and our Allies.

E. N. Twogood has been appointed engineer of the gear department of the General Electric Co.'s works at Lynn, Mass., succeeding A. A. Ross, who has retired after forty-eight years of service. Mr. Twogood has been executive assistant to Mr. Ross since 1923. He entered the General Electric test course at Schenectady in 1910, upon graduating from the University of California with a B.S. degree in electrical and mechanical engineering.

New Jersey

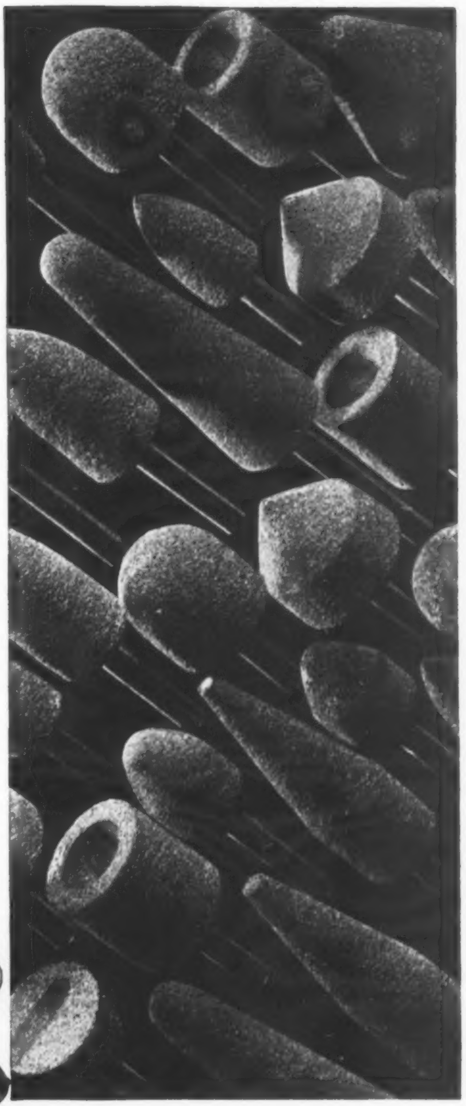
Jack Sandler has joined the staff of the Aircraft Parts Development Corporation, Summit, N. J., as chief plastics engineer. In this capacity he will explore the rapidly increasing use of plastics in airplane construction and equipment. He was formerly con-



A. A. Ross (Left), Engineer of the Gear Department of the General Electric Co.'s Lynn Works, Who has Retired after Forty-eight Years of Service, and E. N. Twogood (Right) Who Succeeds Him

SAY! YOU, UP THERE on the PRODUCTION FRONTS—

No more holding up the steady flow of vital war needs because you're waiting for grinding wheels.



WE'RE RIGHT BEHIND YOU

Can make prompt deliveries on all Mounted Points and Grinding Wheels 3" in diameter and under. We've stopped making the larger sizes for the duration, so we can fill orders quickly for these important smaller sizes.

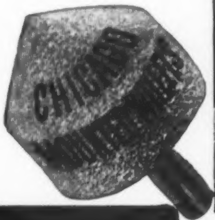
TRY ONE FREE—

Tell us the kind of job, type grinder you use and size wheel you'd like for your test, and we'll send one free postpaid.

CHICAGO WHEEL & MFG. CO.

America's Headquarters for Mounted Wheels

1101 W. Monroe St., Dept. MR, Chicago, Ill.



IT'S OUR WARTIME JOB!

With the approval and endorsement of WPB, all our facilities are concentrated on turning out large quantities of wheels 3" in diameter and under. We're at it 24 hours a day, and keeping up with orders. Our central location is an advantage and means no time is lost between our production line and yours.

NEW CATALOG—shows mounted wheels in actual colors and sizes, portable electric tools and time-saving accessories for grinding, burring and polishing.

MAIL THIS COUPON TODAY

MR-3

( ) Send Catalog ( ) Free Wheel. Size......

Name ....

Address ....

nected with the Northern Industrial Chemical Co. and the Nixon Nitration Works.

New York

AMERICAN LOCOMOTIVE CO. announces a number of changes at the Dunkirk, N. Y., plant of the company: HERMAN FRANCK, who has been general superintendent of the plant, was made plant manager, succeeding the late EDMUND F. BOSWELL. Replacing Mr. Franck as general superintendent is EUGENE MURPHY, who was previously superintendent of the plate shop. Other appointments are as follows: ROBERT MOORE, assistant superintendent in connection with pipe, exchanger, and gun work; ARTHUR GANSLOW, assistant superintendent in charge of exchanger work; ANDREW GROESCH, foreman of the plate shop; and JOSEPH LANGENSTIEN, foreman of the machine shop.

WILLIAM B. MCBRIDE has been appointed production manager of the Bell Aircraft Corporation, Buffalo, N. Y., succeeding M. E. ROE, who is now devoting his attention to problems in the Tool Engineering Division of the company. He previously had charge of process and facilities progress in the office of the director of production. RICHARD E. PALMER, formerly in the Aircraft Division of the War Production Board, has been appointed assistant to O. L. WOODSON, vice-president and assistant general manager of the corporation. He will be assigned to problems concerning manufacturing processes.

WILSON-BROWN CO., 405 Lexington Ave., New York City, will hereafter be known as the HARRINGTON-WILSON-BROWN CO. A new partnership has been formed, with DAN HARRINGTON as the partner holding the controlling interest. No change has been made in the management or personnel of the company, and it will continue to represent the same line of machine tool concerns as formerly, including the Carlton Machine Tool Co., Cincinnati Shaper Co., Barnes Drill Co., Giddings & Lewis Machine Tool Co., Lodge & Shipley Machine Tool Co., Kempsmith Machine Co., etc.

GERARD SWOPE, president of the General Electric Co., has been awarded the Hoover Medal for 1942 by the American Institute of Electrical Engineers, the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, and the American Society of Mechanical Engineers. The medal was presented in New York City on January 27.

HARRY EDMUND NEWELL, assistant chief engineer of the National Board of Fire Underwriters, New York City, has been awarded the James Turner Morehead Medal for 1941 by the International Acetylene Association for his "leadership in developing standards for installation and operation of acetylene equipment and systems."

G. M. BUTLER, formerly research engineer in the laboratories of the Allegheny Ludlum Steel Corporation at Dunkirk, N. Y., has been made chief metallurgist in charge of technical control and research. R. T. EAKIN has been made assistant metallurgist.

PAUL DYER MERICA, vice-president of the International Nickel Co., Inc., New York City, was recently elected to honorary membership in the American Institute of Mining and Metallurgical Engineers.

METROPOLITAN BRONZE MFG. CORPORATION has removed its offices from 92-32 Union Hall St., Jamaica, N. Y., to 55 W. 42nd St., New York City.

Ohio

J. A. IRELAND has been promoted to the position of assistant general manager of sales of the Steel and Tubes Division of the Republic Steel Corporation, Cleveland, Ohio. He previously held the position of division sales manager. Mr. Ireland became connected with the Republic Steel Corporation in the operating department in 1922, upon graduating from high school. From that department he was transferred to the sales department, and was successively salesman, central district sales manager, and division sales manager.

BEAVER PIPE TOOLS, INC., Warren, Ohio, announces a number of changes in its organization: W. A. NERACHER, founder of the company and president for the last forty-three years, has been elected to the newly created position of chairman of the board of directors; W. A. PHILLIS, formerly vice-president, becomes president and general manager; M. W. BECHTEL has been made executive vice-president and treasurer; and C. W. SHAFER, E. R. BARKLEY and R. C. MELLINGER, vice-presidents.

GEORGE H. ADAMS has been promoted to the position of executive vice-president of the Bunting Brass & Bronze Co., Toledo, Ohio. His new position involves supervision over manufacturing, sales, and research operations.

I. H. ANDERSON has been made district manager of sales in New York for the Steel and Tubes Division of the Republic Steel Corporation, Cleveland, Ohio, succeeding L. M. HOGAN, who recently resigned.

Pennsylvania

COMMANDER R. E. W. HARRISON, U.S.N., who returned last July to the Chambersburg Engineering Co., Chambersburg, Pa., in temporary inactive duty status, was recalled to active duty on February 1. Commander Harrison, who has been associated with

Commander R. E. W. Harrison, Who has Resigned as Vice-president of the Chambersburg Engineering Co. to Return to Active Duty in U. S. Navy

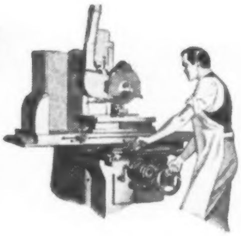
the Chambersburg Engineering Co. as vice-president since 1934, and who was also a member of the firm of Clarke-Harrison, Inc., Philadelphia, management engineers, was in active service in the Navy from July, 1940, to July, 1942. His return to active duty will be in the office of the Under-Secretary of the Navy, serving directly under Admiral H. G. Bowen.

CHARLES E. ROBINSON has been appointed general sales manager of the Sommerfeld Machine Co., Braddock, (Pittsburgh), Pa. In addition to his duties as general sales manager, Mr. Robinson will continue as assistant to the president. He succeeds J. W. HEMMERLE, who for some time has been sales agent for Sommerfeld boring and turning lathes.

RICHARD CALVERT, sales representative in eastern and central Pennsylvania for the Carpenter Steel Co., Reading, Pa., has retired after thirty years of service. AVARD TAYLOR, who has been working with Mr. Calvert, will continue in that territory.

OIL CITY TANK & BOILER CO., Oil City, Pa., has changed its name to ELECTROWELD STEEL CORPORATION, the

To the Skeptic who hasn't yet tried the POR-OS-WAY WHEEL



THE MEN in the armed forces want all you can give them—NOW! You may, as hundreds of war plants have already proved, increase your precision grinding production 2 to 5 times per man per machine with the Por-os-way wheel. Try it!

A YEAR AGO we introduced to industry a new precision grinding wheel. We were confident, after three years' research and scores of actual trials on production work that this new wheel, Por-os-way, would produce 2 to 5 times more work per man per machine. And we said so. At first there were few believers. Our statement seemed incredible. But there was a war to be won. War plants by the score tried Por-os-way, probably with more hope than conviction. They did not fully realize, then, that Por-os-way, being an entirely new kind of wheel, could not be limited by comparison with wheels they had been using.

But skepticism is disappearing. Many operators now *know* that Por-os-way's patented honeycombed structure cools each grinding point between contacts, practically eliminating "burns" in vital war work. Many know that they can double or treble the depth of former cuts and grind in fewer passes of the wheel . . . have seen how the Por-os-way wheel holds its corner and resists "loading", reducing the number of dressings necessary. Many have proved to their own satisfaction that the life of a Por-os-way wheel is at least equal to or better than previous wheels, and know that Por-os-way can produce 2 to 5 times more work per man per machine. But even among Por-os-way's most enthusiastic users, some few are *still not pushing Por-os-way to the limit of its possibilities.* We want you to give this wheel "the whole works." We want you to see for yourself it is all others say it is. Send for "Facts about Por-os-way", with a "prescription blank" for a trial, run to your requirements.

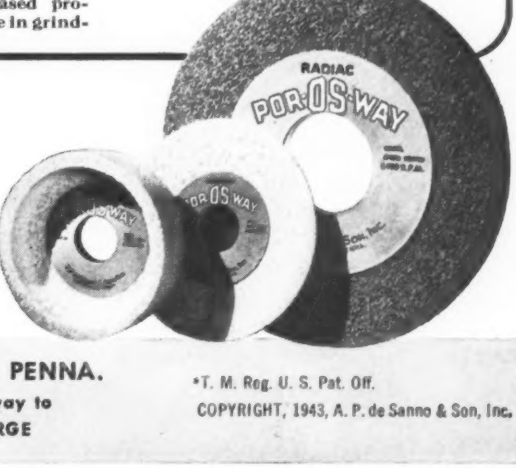
2 TO 5 TIMES MORE WAR PRODUCTION PER MAN PER MACHINE

War plants say, "Tell others what Por-os-way has done for us."

WAR PLANT A—Job: Surfacing oil-hardened, high-speed steel blanks on B & S grinder at 6200 SFPM.
Results: Por-os-way removed .050" in one pass, against .020" previously. Por-os-way wheel lasted 2½ times as long as former wheel, required no dressing, produced no burn, held shape and corner while grinding.

WAR PLANT B—Job: Grinding high-speed cutter tool steel on LeBlond No. 1 at 4750 R.P.M.
Results: Por-os-way increased production 300%. Held a true edge in grinding a *complete* gear cutter. No burning, no loading. Free, cool cutting without dressing. Good finish.

WAR PLANT C—Job: Internal wet grinding on Bryant 16-A machine at 8946 R. P. M. on hardened tool steel—SAE 41/50. Precision grinding.
Results: Obtained 400% better production. Cut fast, free, and cool. Diamond dressed only occasionally to retain shape.



POR-OS-WAY*
a new
RADIAC* PRODUCT

A. P. DE SANNO & SON, INC.
NEW YORK, CHICAGO, PITTSBURGH, CLEVELAND, DETROIT, LOS ANGELES

PHOENIXVILLE, PENNA.
Western Gateway to VALLEY FORGE

entire manufacturing facilities of the company now being devoted to the production of Electroweld tubing. No change has been made in the management or directors.

ROBERT S. SLOAN has been made welding specialist for the Westinghouse Electric & Mfg. Co., in the North Pacific area. In his new post, Mr. Sloan will assist in the application of Westinghouse welding equipment throughout Washington, Oregon, northern Idaho, and Montana.

KEYSTONE CARBON CO., 2028 State St., St. Marys, Pa., has enlarged its powder metallurgy division to include production of small parts of special design and shape for outside customers, thereby eliminating machining operations and conserving man-hours and materials.

CARL J. MEISTER has been appointed manager of sales of the Atlas Metal Stamping and Atlas Tool & Designing Companies, Castor and Kensington Aves., Philadelphia, Pa. He was formerly field sales manager for the Allen Mfg. Co., of Hartford, Conn.

F. B. LOUNSBERRY, vice-president in charge of manufacturing for all plants of the Allegheny Ludlum Steel Corporation, has moved his headquarters to the company's general offices in Brackenridge, Pa.

M. C. MORGAN, formerly field service engineer of the A. M. Byers Co., Pittsburgh, Pa., has been appointed assistant sales manager of the Pittsburgh Division of the company.

Washington, D. C.

OSCAR E. KIESSLING has been elected secretary of the Machinery and Allied Products Institute, succeeding GEORGE TERBORGH, who has been advanced to

George Terborgh, Research Director of the Machinery and Allied Products Institute

Oscar E. Kiessling, New Secretary of the Machinery and Allied Products Institute

the position of research director. Mr. Kiessling, an economist by profession, brings to the Institute fifteen years' experience in research and administration with the U. S. Bureau of Mines, the National Research Project, and the Bureau of Census, having been since 1939 chief of the Mineral Industries Division of the Census. He will be regularly stationed at the Washington, D. C., office of the Institute. Mr. Terborgh was senior economist with the Federal Reserve Board prior to his appointment as secretary of the Machinery and Allied Products Institute in July, 1941. As research director, he will have charge of the study and educational activities of the Institute.

* * *

Reducing Absenteeism in War Industries

"To reduce absence from work in the war industries, the willful absentee must be appealed to at the point that is most vulnerable," says Lew Shalett, of Chicago, Ill. "Like all the rest of us, he would like to have the good esteem of his fellow workers; consequently, plans for discouraging absenteeism should make the worker feel that if he stays away from the job, regardless of whether he merely takes a day off or is prevented from getting to work because of difficult transportation, or for other reasons, his fellow workers are pointing the finger of scorn at him." Posters have been designed to bring out this idea. The experience of several war production plants, large and small, indicates that this program is having the desired effect. The posters used in this campaign were developed by the Sheldon-Claire Co., 520 N. Michigan Ave., Chicago, Ill.

COMING EVENTS

MARCH 25-27—Annual meeting of the AMERICAN SOCIETY OF TOOL ENGINEERS, and MACHINE AND TOOL PROGRESS EXHIBITION in Milwaukee, Wis. Adrian L. Potter, executive secretary, 2567 W. Grand Ave., Detroit, Mich.

APRIL 6-7—WESTINGHOUSE MACHINE TOOL FORUM to be held at the plant of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

APRIL 26-28—Spring meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS in Davenport, Iowa. C. E. Davies, secretary, 29 W. 39th St., New York City.

APRIL 28-30—WAR PRODUCTION CONGRESS and annual meeting of the AMERICAN FOUNDRYMEN'S ASSOCIATION in St. Louis, Mo.; headquarters, Hotels Jefferson and Statler. C. E. Hoyt, executive vice-president, 222 W. Adams St., Chicago, Ill.

JUNE 14-16—Semi-annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS in Los Angeles, Calif. C. E. Davies, secretary, 29 W. 39th St., New York City.

* * *

A Record Attendance Record

As a feature in the drive of the Cadillac Motor Car Division of General Motors to eliminate absenteeism, the company cited for special commendation Joe Hallweck, a man in the assembling department, who has not missed a day's work in twenty-six years, and who has been late only once. That once was in the winter of 1941, when an exceptionally severe snowstorm tied up traffic, causing Mr. Hallweck to arrive one minute late.

Mr. Hallweck is fifty-four years old, a German-born naturalized citizen. The most remarkable feature about his record, according to the Cadillac Labor Management Committee, is that he does not drive to work, but, living on the opposite side of the city, goes to work first by using a bus and then changing to a street car.

* * *

A new type of gage in which a moving indicator and fixed "Go" and "Not Go" limit indicators protrude through a slot makes it possible for blind men and women to perform many inspection operations wholly by the sense of touch.

NEW BOOKS AND PUBLICATIONS

GRINDING WHEELS AND THEIR USES. By Johnson Heywood. 436 pages, 6 by 9 inches. Published by the Penton Publishing Co., Cleveland, Ohio. Price, $3.

This is the second edition of a handbook on modern grinding practice and theory prepared under the auspices of the Grinding Wheel Manufacturers Association. The improvements in grinding machines and wheels and in shop methods that have taken place since the first edition of the book was published in 1938 have made it desirable to revise the text and bring it up to date. The book is actually a clearing house of information which has been obtained in hundreds of shops and represents grinding practices and methods that have been found best in actual use.

There are twenty-nine chapters dealing with the following subjects: The Abrasive Materials; How Grinding Wheels are Made; Theory of Grinding; Surface Qualities and Finishes; Selecting the Right Wheel for the Job; Wheel Shapes and Sizes; Truing, Dressing, and Balancing; Use of Grinding Fluids; Tool and Cutter Sharpening; Sharpening Cemented-Caride Tools; Cylindrical Grinding; Grinding Cams and Other Out-of-Round Surfaces; Roll Grinding; Internal Grinding; Surface Grinding; Disk Grinding; Centerless Grinding; Thread Grinding; Gear Grinding; Grinding Dies and Molds; Lapping; Honing; Superfinishing; Preparing Metallographic Specimens; Cutting Off with Abrasive Wheels; Use of Abrasives in Non-Metal-Working Industries; Grinding Castings, Welds, and Billets; How to Cut Costs and Increase Production; and Some Tips for Product Designers.

ENGINE LATHE OPERATIONS. By Graham G. Whipple and Anthony C. Baudek. 147 pages, 7 3/4 by 10 inches. Published by McKnight & McKnight, Bloomington, Ill. Price, $1.60.

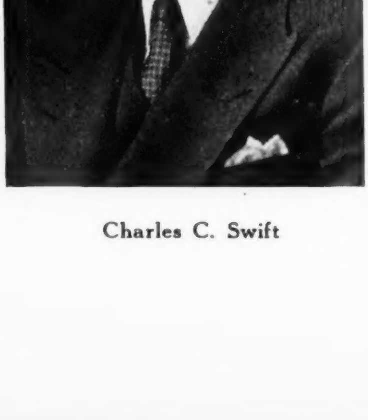
This book was prepared to aid instructors in classes for the training of workers in war production industries. It is made up of a series of units giving concise, step-by-step instructions on how to perform all standard lathe operations. At the end of each unit is given a list of references for further information, and study questions intended to direct the student's attention to the salient points of each unit. The most commonly used charts and tables for the lathe operator are included. Information is given on the use of precision measuring tools and gaging practice. The book is so simply written and clearly illustrated as to be readily understood by students who have had no previous mechanical background.

TESTS OF RIVETED AND WELDED JOINTS IN LOW-ALLOY STRUCTURAL STEELS. By Wilbur M. Wilson, Walter H. Bruckner, and Thomas H. McCrackin, Jr. 76 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin Series No. 337 of the Engineering Experiment Station. Price, 80 cents.

OBITUARIES

Charles C. Swift

Charles C. Swift, president and treasurer of the Ohio Machine Tool Co., Kenton, Ohio, died on January 10 at the Grant Hospital in Columbus, Ohio, at the age of sixty-three. Mr. Swift had been associated with the Ohio Machine Tool Co. since 1911, when he joined the concern as general manager. He was also president of the Swift Welder Co., Detroit, Mich., and a director of the Cleveland Punch & Shear Works Co., of Cleveland.



Charles C. Swift

William J. Harris

William J. Harris, vice-president in charge of purchases for the American Car and Foundry Co. and its subsidiaries since June, 1933, died recently at his home in East Orange, N. J., at the age of sixty-eight years. Mr. Harris had been connected with the American Car and Foundry Co. and its predecessor companies for more than fifty years.

He was born at Swansea, Wales, and came to the United States in 1880, where he was educated in the public schools of Berwick, Pa. In 1889, he entered the employ of the Jackson & Woodin Mfg. Co., Berwick, Pa., as a shipping clerk in its rolling mill. When that company was taken over by the American Car and Foundry Company in 1899 he became bookkeeper for the latter company. Mr. Harris was steadily promoted until he became supply agent for the company in the Berwick district. In April, 1920, he was transferred to New York as assistant purchasing agent and in July, 1923, became purchasing agent for the entire organization. In June, 1933, Mr. Harris was elected vice-president in charge of purchases. He is survived by his wife, Mrs. Bertha S. Harris.

MASON HULETT, well known throughout the gear industry, died suddenly on February 7 in Washington, D. C. Mr. Hulett had been in Washington for several weeks serving as chief of the Industrial Gear and Speed Reducer Unit, Material Handling Equipment Branch, of the War Production Board. Prior to his association with the War Production Board, he had been connected with the New York office of the Farrel-Birmingham Co., and previous to that with the Falk Corporation.

SVEN J. WILLIAMSON, a salesman with the Giebel Machine Tool Co., New York City, died on February 5. Previous to his connection with this company, Mr. Williamson had been a tool supervisor with the Otis Elevator Co. of Yonkers, N. Y.

* * *

Preventing Dust Explosions in Industrial Plants

Under the title "National Fire Codes for the Prevention of Dust Explosions," the National Fire Protection Association, 60 Batterymarch St., Boston, Mass., has published a 160-page book covering the fundamental principles of dust-explosion prevention in industrial plants. Among the specific industries for which codes are included are the manufacture of aluminum-bronze powder, and woodworking. The price of the book is $1.

and now....

A LINE OF SPECIAL "*Detroit*" HIGH PRECISION TAPPING MACHINES

At Left—

Series LTM Light Duty High Precision Tapping Machine

At Right—

Series HTM Heavy Duty Precision Tapping Machine

Intermediate Sizes also available.

ith such features as:

- Spindle nose guided during entire stroke
- Lead-Screw driven at bottom, eliminating inaccuracies due to "wind-up"
- Available with single or multiple tap heads
- Automatic reverse and return stroke
- No end play in tap spindle

For complete details write for Bulletin No. TM-43

ETROIT TAP & TOOL *Company* 8432 BUTLER DETROIT

Classified Contents of This Number

Aircraft Manufacture and War Production

Management Problems

Materials, Metals, and Alloys

Meetings and Exhibits

News of Industry

Salvage of Critical Materials

Shop Practice, General

Your Progress Depends Upon Your Knowledge of Your Industry

Plenty and On Time!

By
Major-General LEVIN H. CAMPBELL
Chief of the Ordnance Department
United States Army

THE illusory defense era for the United States came to an end when enemy bombs rained on Pearl Harbor. Immediately industrial America put its shoulder to the wheel with renewed determination, and a miracle of conversion to war production was accomplished. Also, we went over the hump of production for *preparation* into nearly full production for *use*. The Ordnance Department of the U. S. Army was catching up on the Army's gargantuan needs for weapons. The Indus-


Photo U. S. Army Signal Corps


Photo Office of War Information

try-Ordnance team, at bat for more than a year previously, forged ahead the minute the carnage of Pearl Harbor was known.

Last year, America's Army grew to seven million, of which half a million were overseas. These figures were disclosed by the President in his message to Congress. He also disclosed some others: Last year, we produced 50,000 combat vehicles, such as tanks and self-propelled artillery; the output of machine guns was 670,000, six times greater than our production in 1941, and three times greater than our total production during the year and a half of our participation in the first World War. Of anti-tank guns, there were 21,000 built, or six times as many as the preceding year, while ten and a quarter billion rounds of small-arms ammunition were turned out, five times greater than our 1941 production and three times greater than our total production in the first World War. As for artillery ammunition, we produced 181,000,000 rounds in 1942, which was twelve times greater than the 1941 production, and ten times greater than our total production in the first World War.

At the end of the current year, we expect to have at least a million well equipped soldiers in the firing line all over the world, and when we say well equipped, we mean equipped with the best. We overlook no bet to get the best. We even comb the enemy's equipment, just in case they may have an item superior to ours. So far they have not out-engineered us. We constantly capture enemy equipment on every battle front around the world. We send it to our Ordnance experts at the Aberdeen Proving Ground, and they test it from every angle, take it apart, study its assembly and design, analyze its components for new and useful alloys. So far this work has turned up little or nothing that we are not already away ahead of. The Garand rifle has two and a half times the fire power of any foreign rifle. Our tanks are superior. The 105-millimeter gun, mounted on a medium tank chassis, is the world's best tank killer; and so on.

Our fighting forces, as well as their weapons, have been put on wheels, armies have been mechanized, the automotive principle has been adopted, and its effect on the Army has been even more profound than it was on civilian life. Today the mechanized division has 32 horsepower for every soldier in it, 400,000 horsepower in all. The job of developing and equipping the U. S. Army with this materiel, as well

Photo British Combine

Photo U. S. Army Signal Corps

as the more than 1700 other items, including pistols, rifles, machine guns, anti-aircraft guns, trench mortars, hand grenades, tanks, armored cars, scout cars, ammunition, cannon of all sizes, shell, fire control instruments, bombs, etc., is a Herculean task, but the Ordnance Department is in its stride. It has expanded its arsenals; expanded its thirteen Ordnance Districts; it has undertaken the conversion of something like half of our civilian industry to war production; it has erected and equipped dozens of Ordnance-owned, privately operated factories all over America; it has built up a new explosives industry; and last, but not least, it is in process of creating the greatest war materiel maintenance system this world has ever seen.

With the design, purchase, and maintenance of motor vehicles, combat and otherwise, now centralized under the Ordnance Department, an Ordnance Tank Automotive Center was also established in Detroit. This is in addition to the seven motor supply depots scattered throughout the country to furnish motor supplies and spare parts; light and heavy maintenance companies of troops to care for and maintain vehicles; truck companies of troops to operate them; various repair shops, training schools, and other facilities. A huge reservoir of spare parts was developed, and the personnel created for handling, storing, shipping, and distributing to theaters of war all around the world.

When a tank, gun, or other fighting tool is put out of action, Ordnance troops must repair it in the shortest possible time. Therefore, rolling machine shops, together with repair trucks for many special purposes, and wrecking trucks weighing 36,000 pounds each and equipped with 10-ton cranes and winches capable of pulling 55,000 pounds, etc., were developed and produced in mass quantity for use on the battlefield.

The colossal proportions of the maintenance problem can be partially gaged from the fact that the vehicles of a motorized triangular division will make a column 30 miles long if placed at 10-yard intervals. There are 2434 motor vehicles, and the prime movers tow 275 trailers and 116 guns. Together the 16,129 men and officers and the equipment of such a unit weigh 3753 tons, and would require 1707 freight cars or 17 trains, each a mile long, to move them.

All this indicates the scope of our military armament job. It is a tremendous task. It requires the continued help of Industry. We are counting on that help. With it we will not fail!

Small-Arms

FROM ONE OF

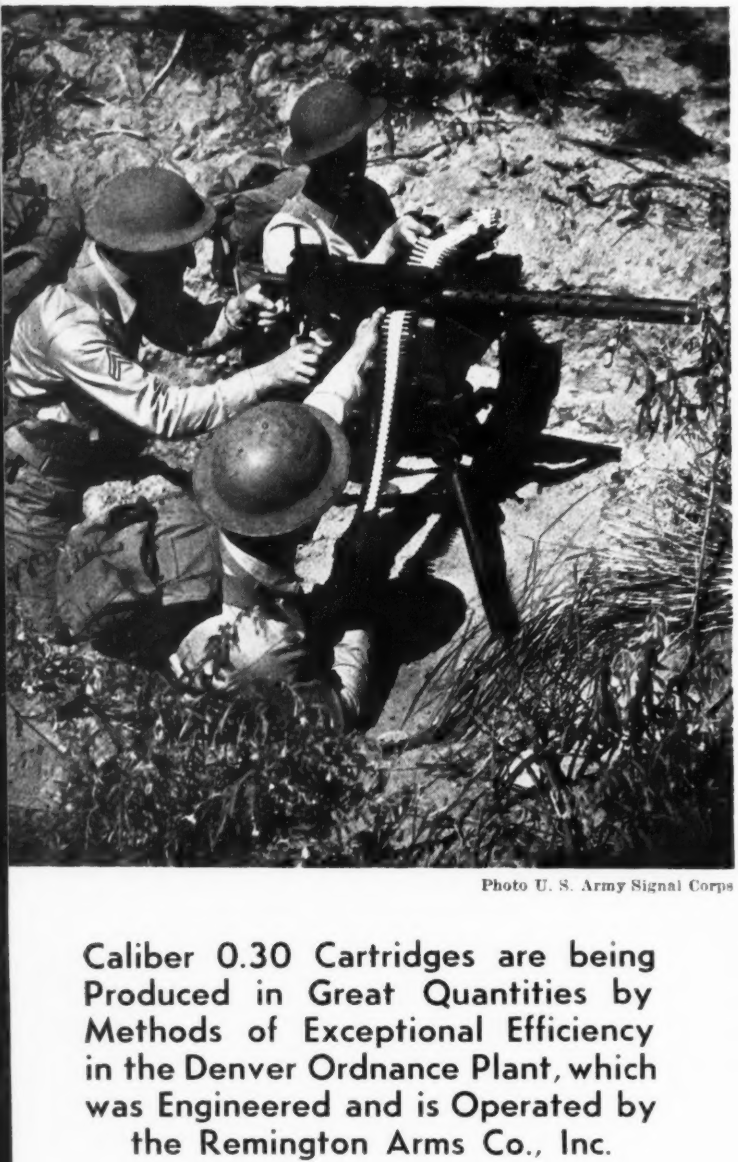


Photo U. S. Army Signal Corps

Caliber 0.30 Cartridges are being Produced in Great Quantities by Methods of Exceptional Efficiency in the Denver Ordnance Plant, which was Engineered and is Operated by the Remington Arms Co., Inc.

By CHARLES O. HERB

SMALL ammunition of the calibers used in rifles and machine guns is required in astronomical quantities in this global war. Millions of rounds of small-arms ammunition are fired daily in desert and steppe combat and by our infantrymen in South Sea jungles. It has been estimated that fifty fighting planes alone can use up three hundred thousand rounds of small ammunition in one minute. One whole division of ten thousand men in Napoleon's army would not have used up that much ammunition in a day's battle. According to the President, we produced 10,250,000,000 rounds of small-arms ammunition in 1942.

That our facilities for producing small-arms ammunition are considerably more than adequate to meet the huge demand should be a source of great pride to all Americans. This is due to the farsightedness of the Army Ordnance Department, which, in conjunction with old-line ammunition companies, laid extensive plans for expanding the manufacture of war materials years before our entry into the war. Frankford Arsenal assumed a leading role in this work through the perfection of a model factory for turning out small-arms ammunition by the latest developments in mass production methods. The plans developed covered the design of buildings, machinery, tools, calculation of requirements for raw materials, personnel, power, transportation facilities, and so on.

Model factories for the production of caliber 0.30 and 0.50 cartridges were set up and in actual operation before the end of 1939. The methods here developed were adopted by both the British and Canadian Governments as standard in the procurement of equipment for small-arms ammunition factories. It was largely on the basis of the Frankford Arsenal methods that old-line ammunition companies and other industrial concerns who had had no previous experience in the production of small-arms ammuni-

Ammunition

REMINGTON'S NEW PLANTS

tion were able to undertake the building and operation of new ammunition plants for the Government. Under this leadership of Frankford Arsenal, methods of producing small-arms ammunition were evolved that constitute the best practice followed anywhere.

One of the finest of the new small-arms ammunition plants is the Denver Ordnance Plant, Denver, Colo., which was planned by the Remington Arms Co., Inc., and is now being run under Remington management. Conceived with customary duPont ingenuity (the Remington Arms Co., Inc., being a duPont subsidiary), this plant operates with an efficiency that would be a revelation to most production men. From the time that the component parts for cartridges start in production until the finished cartridges leave the plant, boxed for shipment to War Department depots, parts are seldom touched by hand. Work is carried to and from machines by belt conveyors, and all machines are hopper-fed. The plant is arranged in individual units, each of which is equipped for the manufacture of caliber 0.30 cartridges of armor-piercing and ball types, and two of the plants also are equipped to produce tracer types. This set-up enables manufacture to be conducted with maximum economy. Should it be necessary to curtail production at any time, one or more units could be shut down and the others still be operated at 100 per cent efficiency.

The high efficiency of this plant is the more remarkable in view of the fact that it is located in a section of the country where skilled mechanical help was not available in required numbers. When the erection of the plant was decided upon, the Remington Co., hired about five hundred men, mostly from the vicinity of Denver, for supervisory positions in the plant. These men were transported to the parent plant at Bridgeport, Conn., and there trained in ammunition manufacture. Approximately two hun-

Fig. 1. Cartridge Cases are Carried from Machine to Machine by Conveyor Belts and Elevators; the Conveyor Here Seen Brings the Cups from the Receiving Department and Unloads Them into Bins for Delivery to the Hoppers of the First-draw Presses

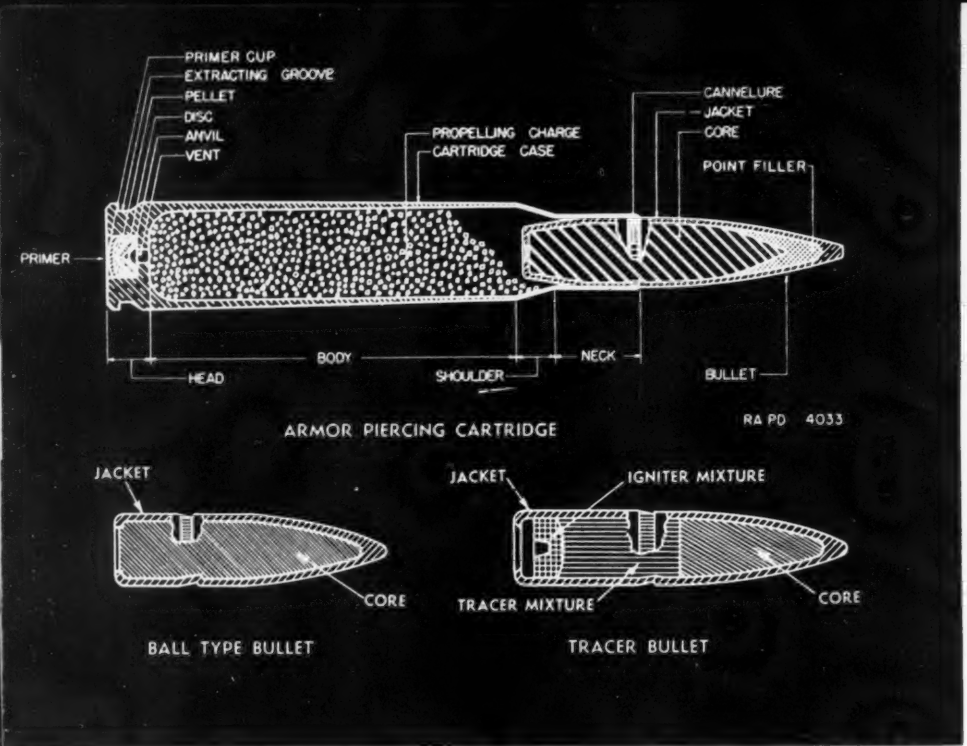


Fig. 2. (Left) Different Types of Bullets Produced for Small-arms Ammunition Manufactured at the Remington-operated Denver Ordnance Plant

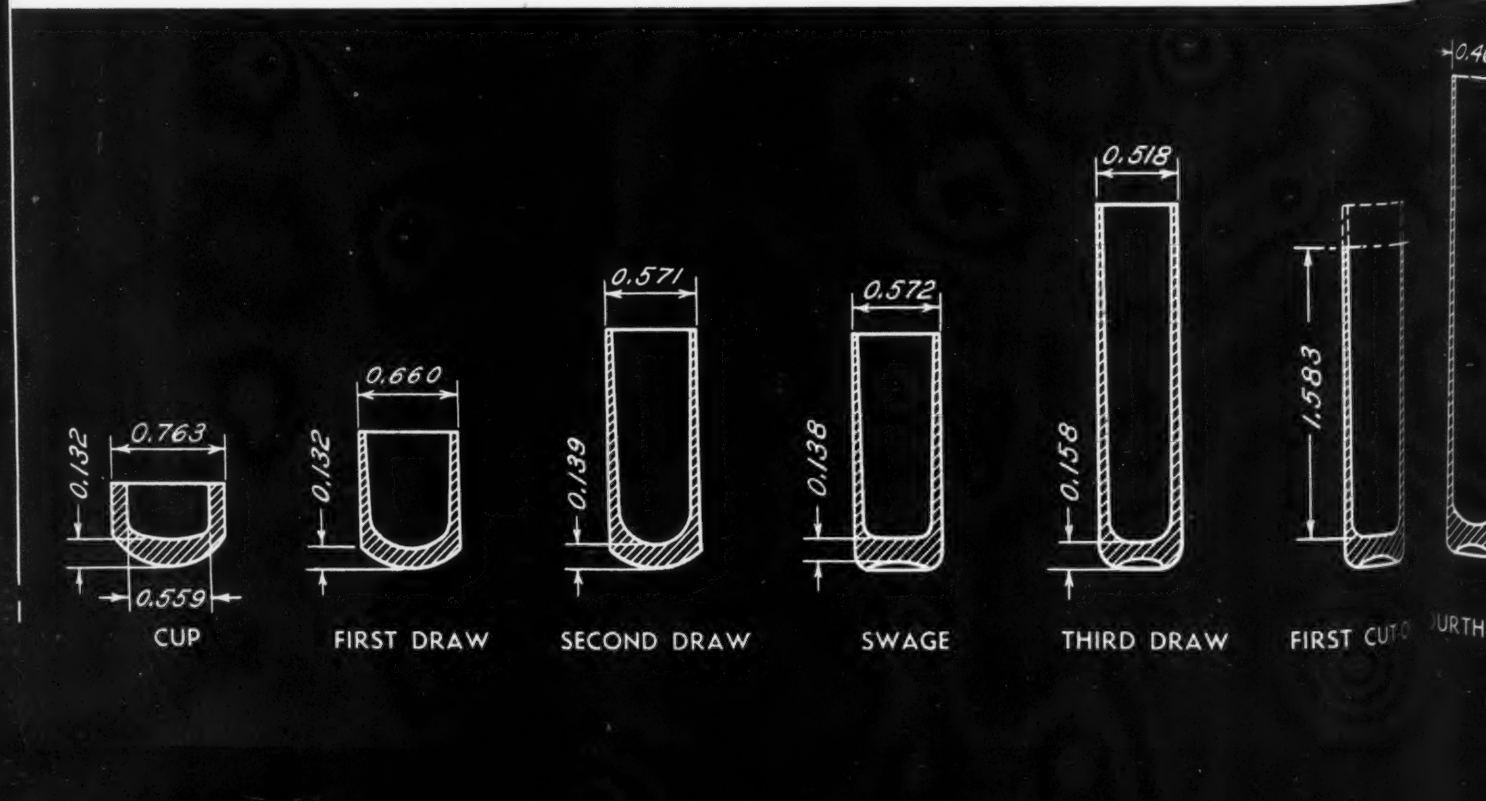
Fig. 3. (Below) Diagrams Indicating Successive Steps in Press and Machine Operations on Cartridge Cases

dred men of this trained nucleus are still at the Denver plant. The others have been assigned to help operate other Remington plants. Only a small percentage of the help at the Denver plant can be considered skilled. About half the employes are women, and it is estimated that the proportion will increase.

It is well known that small-arms ammunition must be manufactured to almost unbelievably strict specifications. With the advent of the use of this ammunition in large quantities on airplanes, where the machine guns are not accessible to the plane crews, these specifications have been made even stricter, because the failure of a single cartridge would cause stoppage of a gun until the plane returned to its base. The Denver Ordnance plant has been successful, not only in meeting the required specifications, but also in producing ammunition accepted as aircraft quality in quantities far beyond the original expectations.

The differences between the three types of caliber 0.30 cartridges to be discussed here are in the bullets, as will be apparent from Fig. 2, where it will be seen that a ball type bullet consists of a solid lead core with a gilding-metal clad steel jacket; an armor-piercing bullet is made up of a steel core with a small lead core at the point end and a lead cap at the heel, all of which are covered by a gilding-metal jacket; and a tracer bullet consists of a comparatively short lead core backed up by a tracer mixture and an igniter mixture, all of which are contained in a copper-alloy jacket.

The manufacture of the cartridge cases will be described first. They are produced from



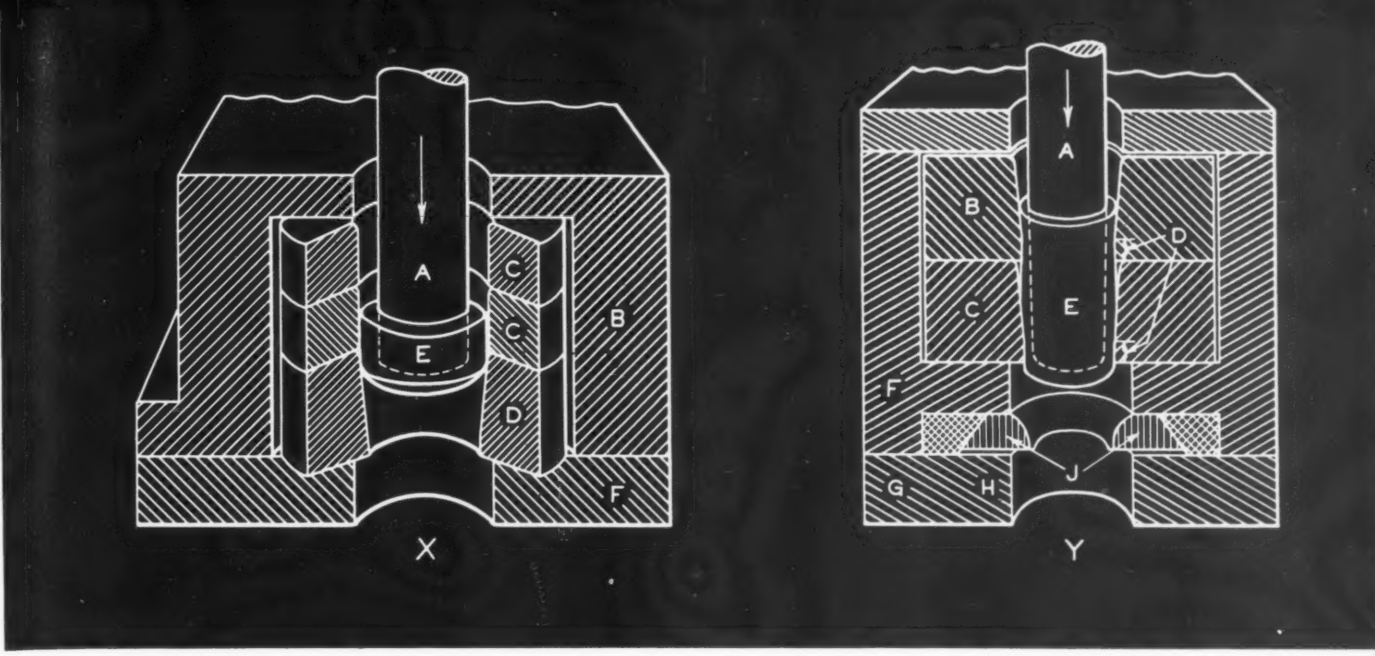
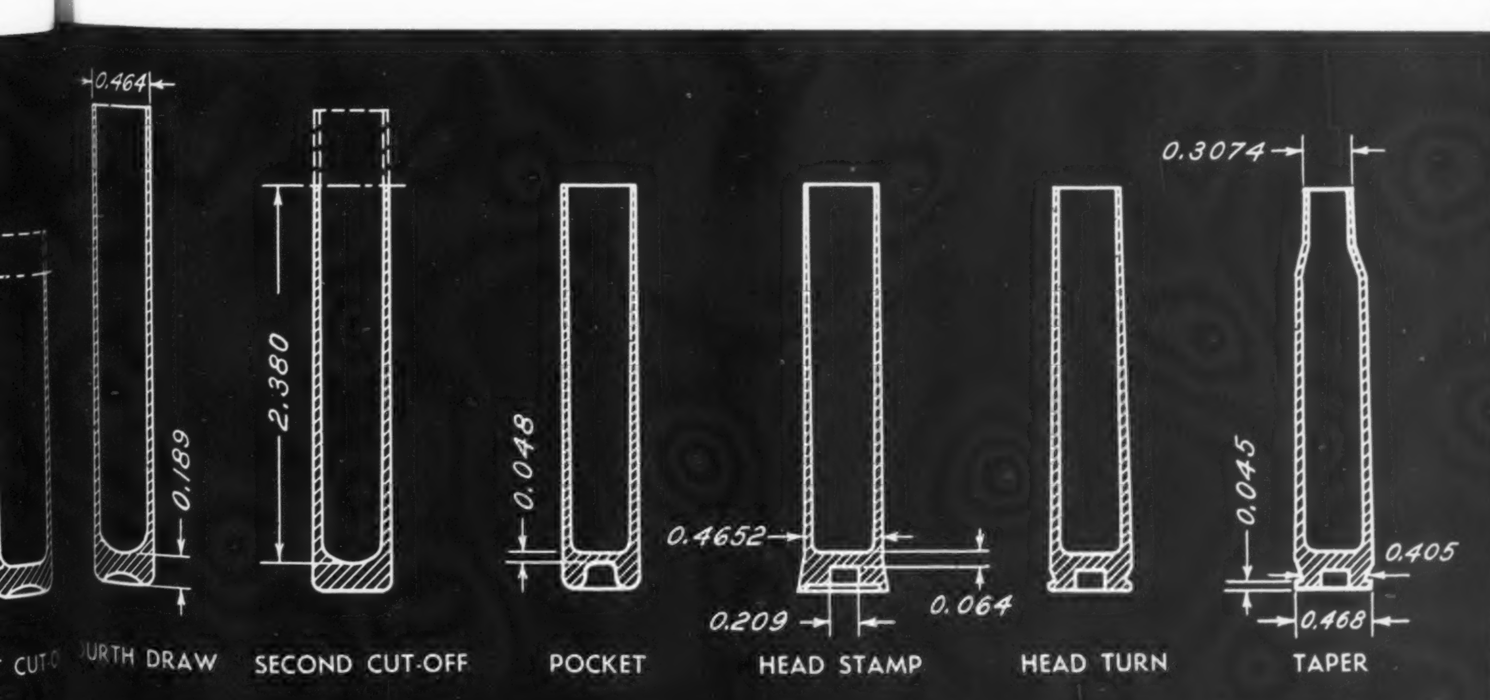


Fig. 4. (Left) Diagram Showing Construction of Floating Dies Used for First Draw on Cartridge Cases. Fig. 5. (Right) Construction of Dies Such as Used in Second Draw on Cartridge Cases

small copper-alloy cups, such as indicated at the left in Fig. 3. These cups are supplied by another manufacturer, already blanked and drawn to the specified dimensions and thoroughly washed. From the receiving department the cups are carried by a conveyor to the mezzanine floor of the building, directly above a row of power presses, tooled up for performing the first drawing operation. The conveyor carries the cups, as shown in Fig. 1, to several hoppers, or "bathtubs," from which they slide down pipe-like chutes to hoppers on the drawing presses.

Bliss single-stroke duplex presses are used for the first drawing operation; a close-up view of one of these machines is shown in Fig. 6. Each side of the machine is provided with two punches, so that four cartridge cases are drawn per revolution of the crankshaft. The cups are fed to the table by a rotary hopper driven from the crankshaft of the machine at a speed of about 34 R.P.M. A notched ring insures that the cups will slide down through the chute with the closed or base end downward. The weight of the cups in the chute is sufficient to push them forward on the table, and they are distributed by the operator to two disks that revolve in a horizontal plane, one of these disks being on each side of the machine. These disks feed the cups into separate gates that lead to each of the four dies.

As the cups move into position they revolve a star-wheel which registers the number of cups passing by. They then advance through slots to the dies. In Fig. 6, as in many of the other illustrations, the guards that normally protect the operator were removed when the photograph



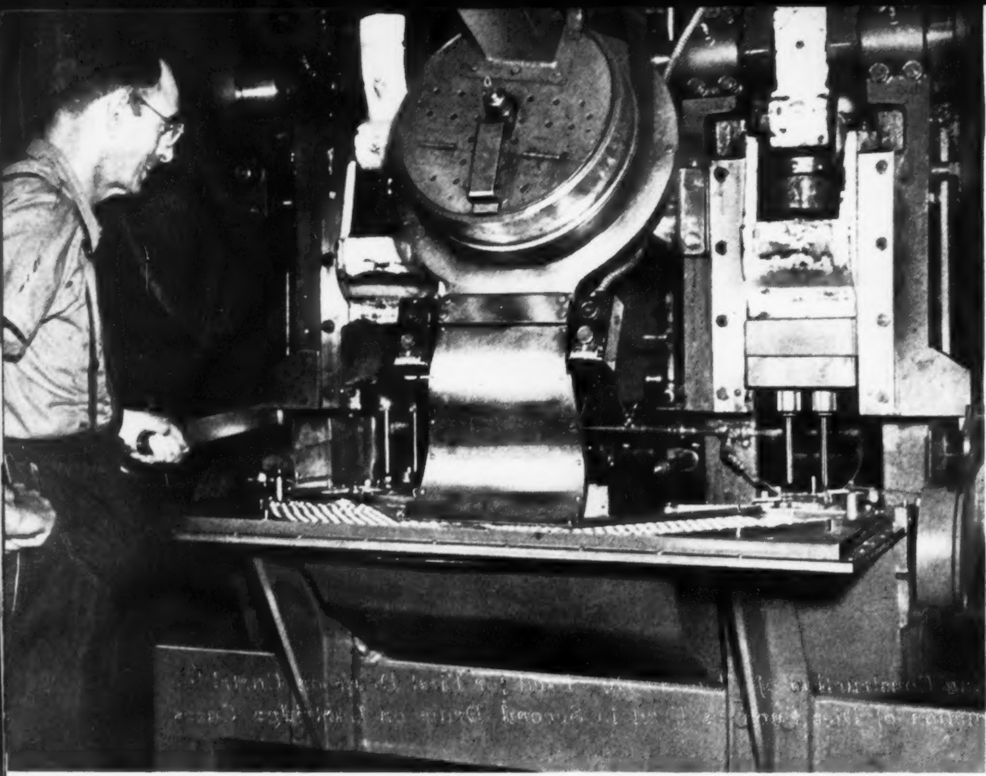


Fig. 6. The First Drawing Operation on the Cartridge Cases is Performed on a Press Provided with Four Sets of Dies and Punches

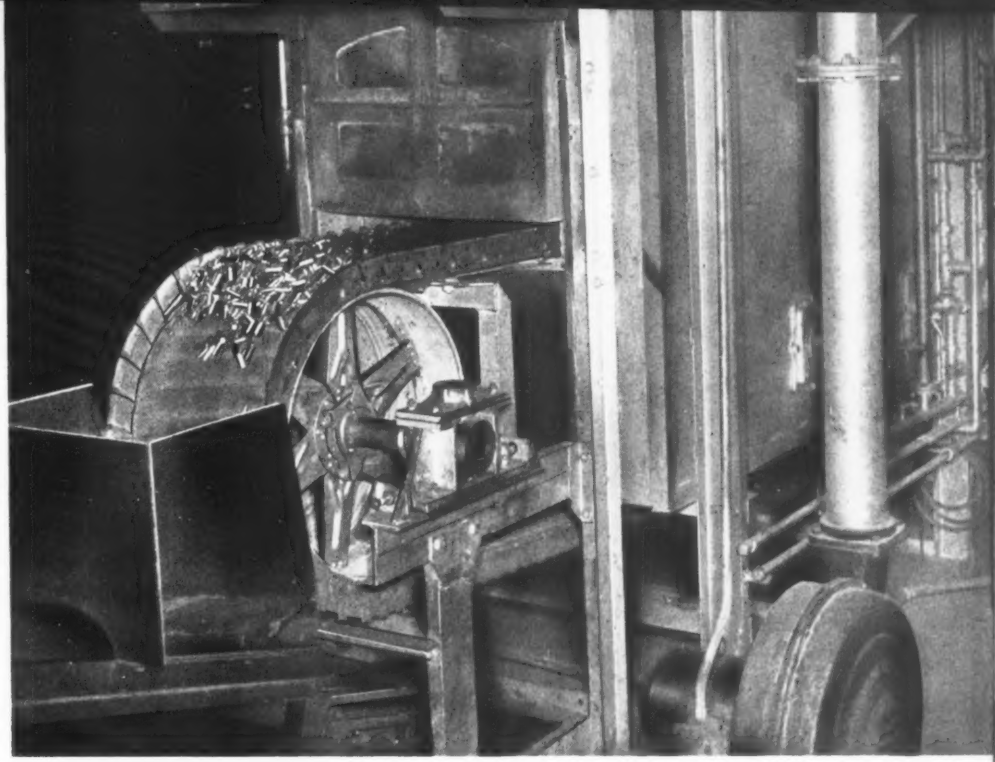
was taken to give a more complete view of the tools.

Each drawing die for this operation is of the floating construction illustrated diagrammatically in Fig. 4, in which punch A is shown pushing a cup E through the die. There are two guide rings C above die ring D. The size of the cups as they enter the dies is roughly 3/4 inch in diameter by 29/64 inch deep. They leave the dies 21/32 inch outside diameter by 13/16 inch deep, and with a wall 1/16 inch thick. The cartridge cases slide from the dies down chutes that lead to the back of the machine, as illustrated in Fig. 7, where they can be trapped by gates until a quantity has accumulated.

The operator inspects several of the cups in each batch before releasing them, as seen in Fig. 7, and allowing them to slide on a belt conveyor which extends the full length of the row of first-draw presses. The conveyor carries the cases to a Palmer-Bee vertical bucket type elevator, which transports them to the floor above. There they are automatically unloaded into a hopper, which delivers them to a steel conveyor belt that carries the cases slowly through a Salem natural-gas fired annealing furnace, such as seen in Fig. 8. The discharge end is shown in the illustration. It takes about one-half hour for the cases to pass through this furnace, which is operated at a charging-zone temperature of

Fig. 7. As the Cartridge Cases Leave Various Draw Presses, They Automatically Slide onto Conveyors which Carry Them to Vertical Elevators for Transferal to a Mezzanine Floor

Fig. 8. Discharge End of a Long Annealing Furnace through which the Cartridge Cases are Carried by Means of a Wire-mesh Belt



1325 degrees F. and a soaking-zone temperature of 1300 degrees F. The belt speed is 12 inches a minute.

While they are in the furnace, the cartridge cases become discolored, and the drawing lubricant on the cups when they enter the furnace is burned off, leaving a residue. To remove the discoloration and residue, the cases are automatically dumped from the end of the annealing furnace into the first unit of the pickling, washing, lubricating, and drying unit shown in Fig. 9. First the cases are tumbled in a bath of weak sulphuric acid. They are then discharged into a revolving wash tank, next into a rinsing tank, and then into a tank that contains a soapy solution which serves as a lubricant in the next drawing operation. The cases finally pass through the drying oven seen in the foreground of Fig. 9, which delivers them to a chute from which they are fed through pipes to the hoppers of the second-draw presses on the floor beneath.

The second drawing operation is performed by Bliss straight-side single-crank presses, set up with four punches and dies as shown in Fig. 10. A hopper at the upper left of the machine feeds the cases downward through flexible tubes, with the closed or base end down, to feeder-block grooves. Pawls fastened to an oscillating shaft, which is driven from the crosshead of the machine, advance the cases along

Fig. 9. Discharge End of a Pickling, Washing, Lubricating, and Drying Unit into which the Cartridge Cases are Loaded as They Come from the Furnace Seen in Fig. 8

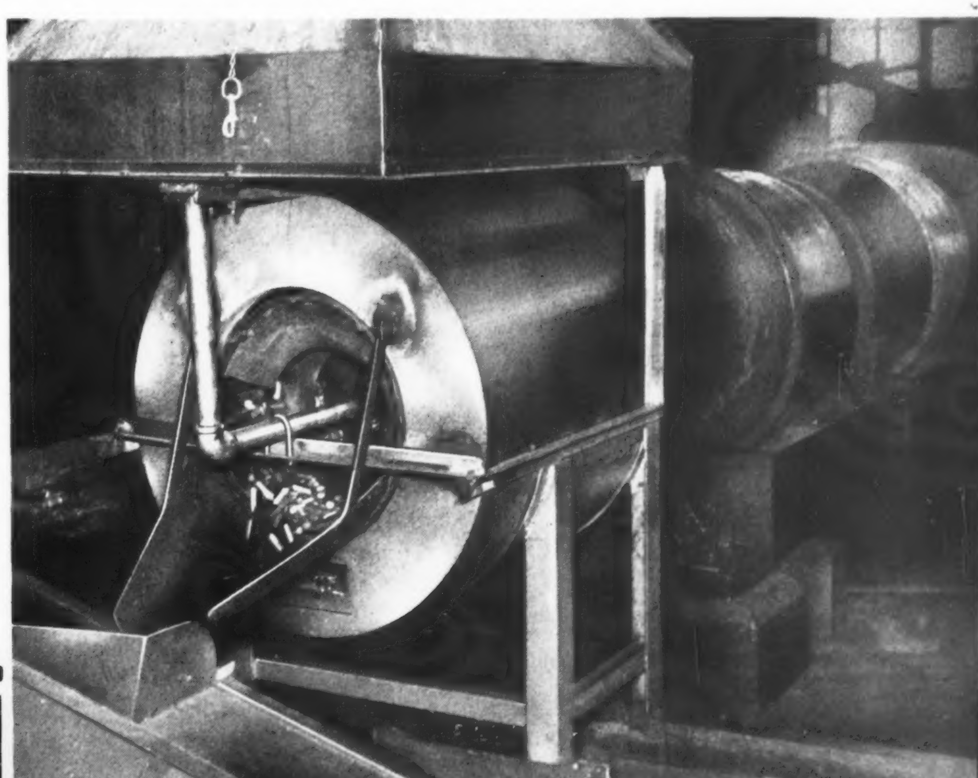


Fig. 11. Conveyor Belt at the Back of One of the Second-draw Presses. An Elevator that Carries the Cases to the Mezzanine Floor is Seen in Background

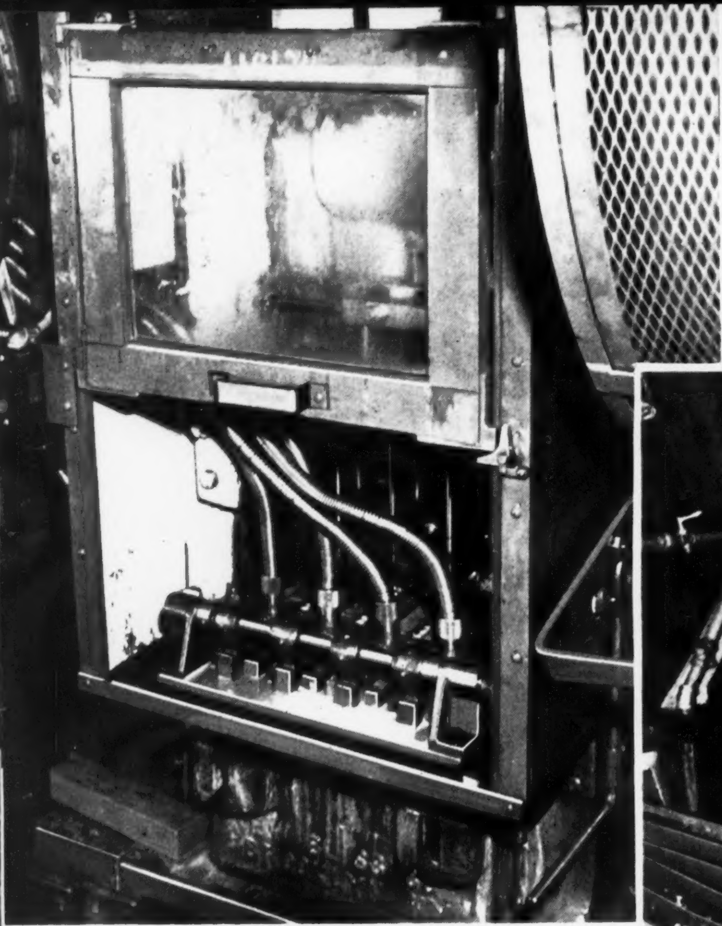


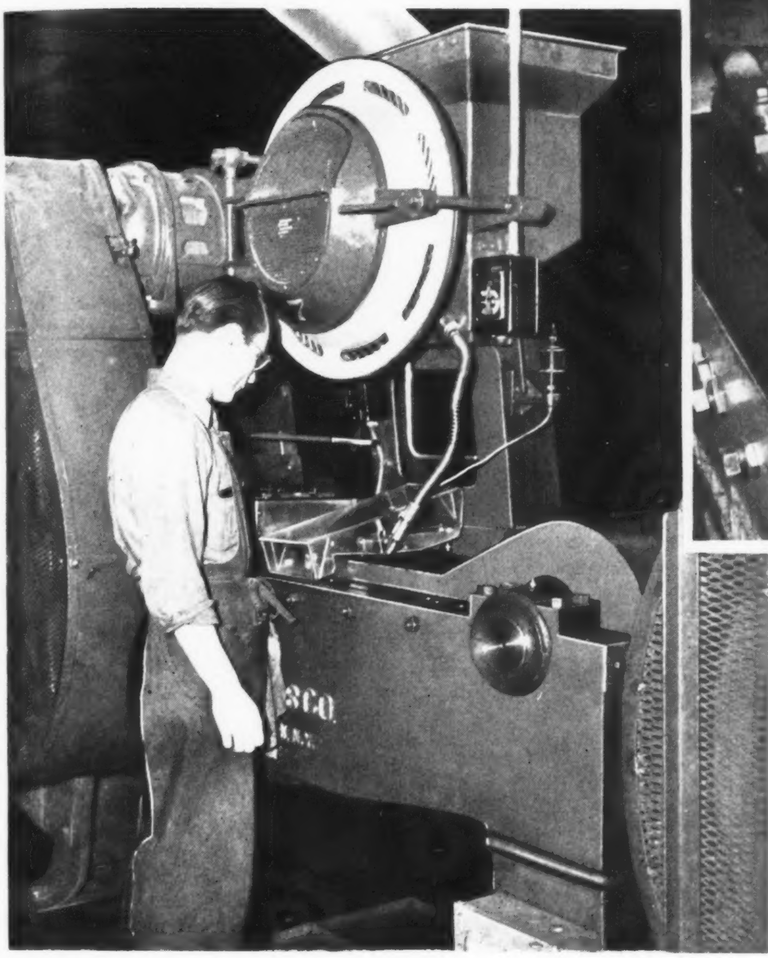
Fig. 10. A Straight-side Single-crank Press with Four Punches and Dies, Used for Performing the Second Drawing Operation on Cartridge Cases

these grooves the distance of a case diameter with each revolution of the press crankshaft. Eventually, each case drops into a die at the forward end of the feeder grooves, but before they reach the dies, fingers on the punch ram descend into each cup to make certain that no cup becomes inverted accidentally. An inverted cup would prevent one of these fingers from completing its stroke and the machine would then be automatically shut off before damage could occur to the corresponding punch and die.

Each set of dies for this operation consists of a top die B, Fig. 5, a bottom die C, and a stripper J. The stripper is a collar consisting of three segments, which are held together by a coil spring eye. The stripper expands to permit a case E to pass through the die on the downward stroke, but is immediately contracted to the punch diameter when the upper end of the case has passed through, and thus prevents the case from returning upward with the punch A. Fig. 11 shows cases being discharged from one of the second-draw presses to a conveyor belt before being carried to a washing operation on the floor above. The lower part of the Palmer-Bee elevator that serves the row of second-draw presses can be seen in the background.

Washing and drying of the cases after the second draw are performed as they are fed through Colt Autosan equipment such as illustrated in Fig. 14. The work-handling unit is a 12-foot perforated cylinder, about 2 feet in diameter, which is provided in the center with a conveyor screw. The work-pieces are advanced about 8 inches per cylinder revolution. During the first 6 feet of cylinder length, the cases are

Fig. 12. Type of Machine that is Employed for Swaging or "Bumping" the Base End of Cartridge Cases and also for Forming the Primer Pocket



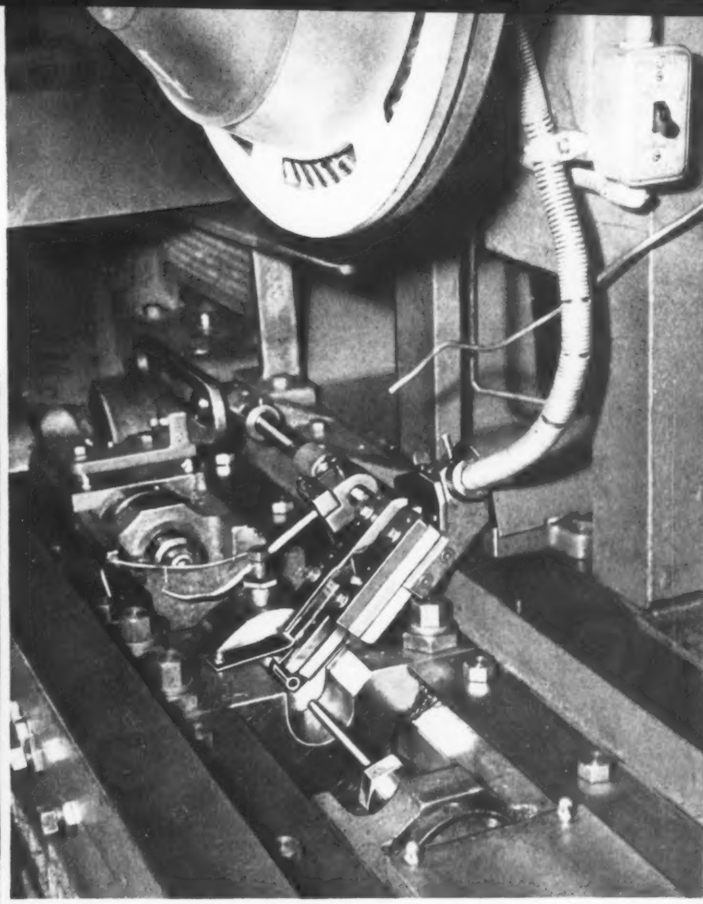


Fig. 13. Close-up View of One of the Base-end "Bumping" Machines, Showing the Injecting Stem Advancing to Push a Cartridge Case into the Die

washed and rinsed, while in the next 6 feet of length they are dried by a gas-fired hot-air unit. In the washing section, a scoop attached to the cylinder picks up a solution of Pennsalt and water, and pours it on the tumbling cartridge cases. The solution drains back into the tank through the cylinder perforations. In the rinsing operation, hot water is similarly scooped up and poured on the tumbling cases.

The next operation consists of "bumping" or swaging the base end of the cases, as indicated by the fourth diagram from the left in Fig. 3. This operation is performed on horizontal toggle and crank presses built by the E. W. Bliss Co. and the Jarecki Machine & Tool Co. A general view of a Bliss machine being used for this operation is seen in Fig. 12, and a close-up view of a Jarecki machine in Fig. 13.

Again, the cases are fed through pipe chutes from the floor above to hoppers on the machines, which, in turn, feed the cases, base downward, through a flexible tube, as shown, to a transfer slide. As this slide moves toward the front of the press it brings the cartridge case in line with an injecting stem operated from the right-hand end of the machine, as seen in Fig. 13. When this stem moves to the left, it pushes the case from the transfer slide into a die and forces it part way through the die, so that the open end projects about 3/64 inch beyond the left-hand end.

While the case is held in this position, a punch moves from the left-hand end of the machine and strikes the base or head end of the cartridge case. The injecting stem serves as an anvil during this portion of the operation. The stem and

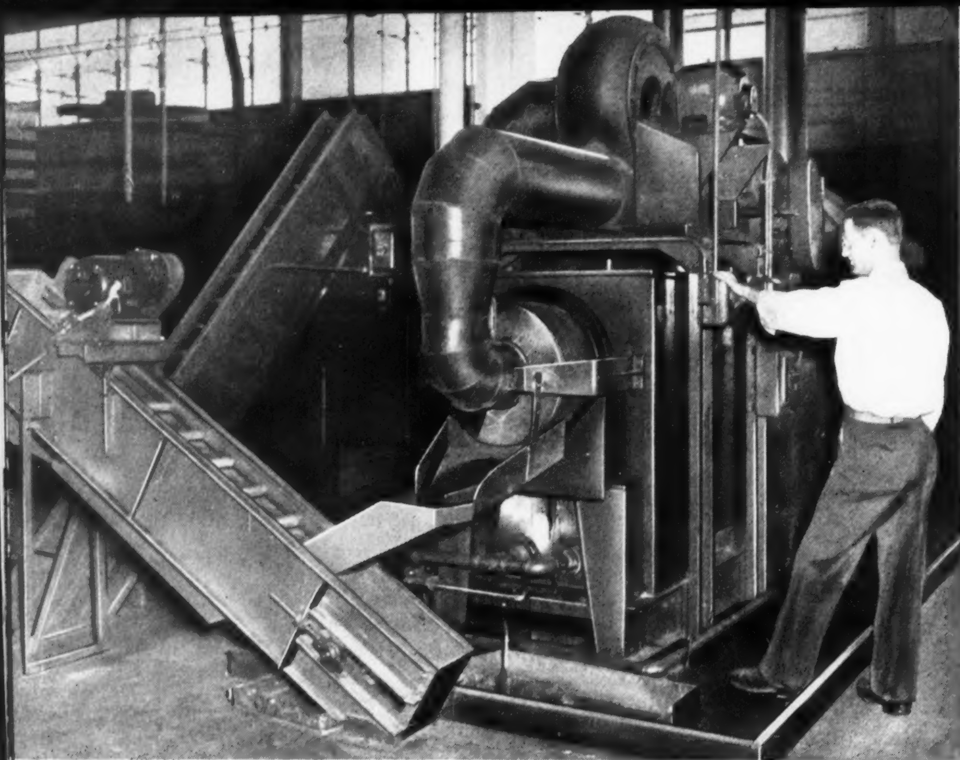


Fig. 14. Washing and Drying Unit that Thoroughly Cleanses the Cartridge Cases after the Second Draw. The Cases are Discharged into Short Conveyor Units which Carry Them to Chutes for Delivery to the Hoppers of Base-end Swaging Machines

punch next recede in opposite directions, completing the cycle of operation.

When the next cycle occurs, the "bumped" case is ejected as the next case is pushed into position by the stem. The "bumped" case falls into a chute which carries it to a batch box at the back of the machine. The method of ejection is shown diagrammatically in Fig. 15, in which the "bumped" case is seen at *A* and the oncoming case at *B*. There is a knock-out finger which oscillates up and down beyond the left-hand side of the die, in order to make sure that the ejected cases will drop out of the way of the punch before each forward stroke has been completed.

The "bumped" cases are carried by a conveyor and elevator to the mezzanine floor, where they are annealed a second time in a Salem furnace similar to the one illustrated in Fig. 8, and are again pickled, washed, and dried by equipment identical to that shown in Fig. 9. From the dryer they go to a storage hopper, and are released to chutes that lead to the third-draw presses as required to keep these presses fully supplied. This operation is performed on the same type presses used in the second draw, the

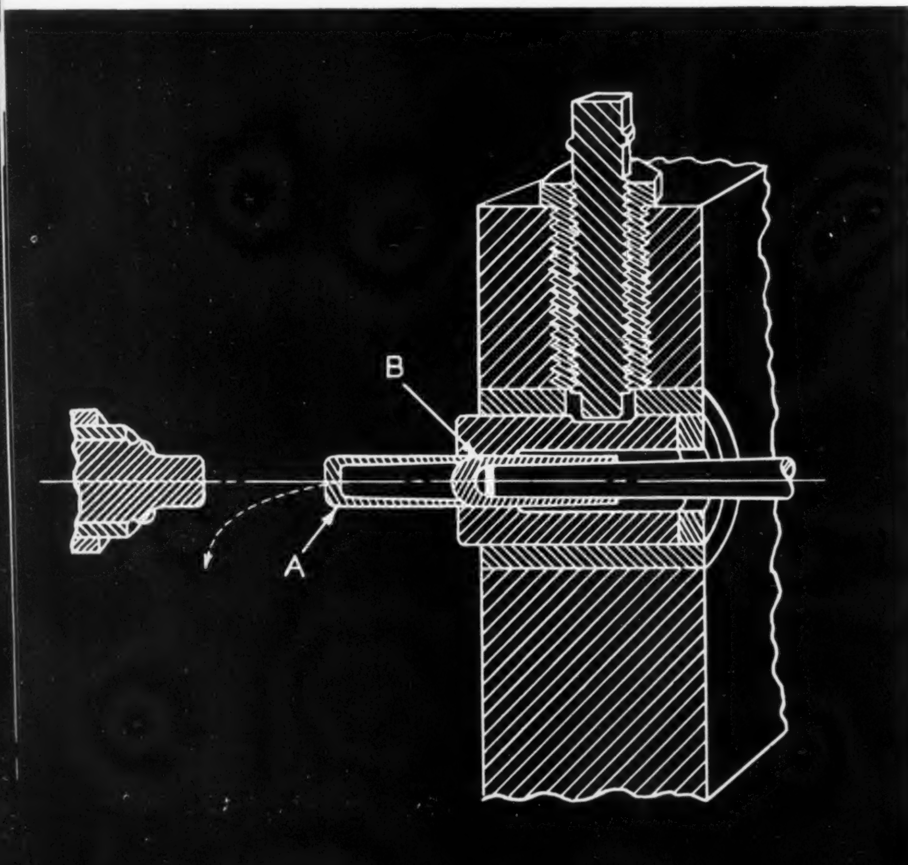


Fig. 15. Diagram Illustrating the Manner in which a Swaged Case is Pushed out of the Die of a "Bumping" Machine as the Injecting Stem Brings a New Case into the Working Position

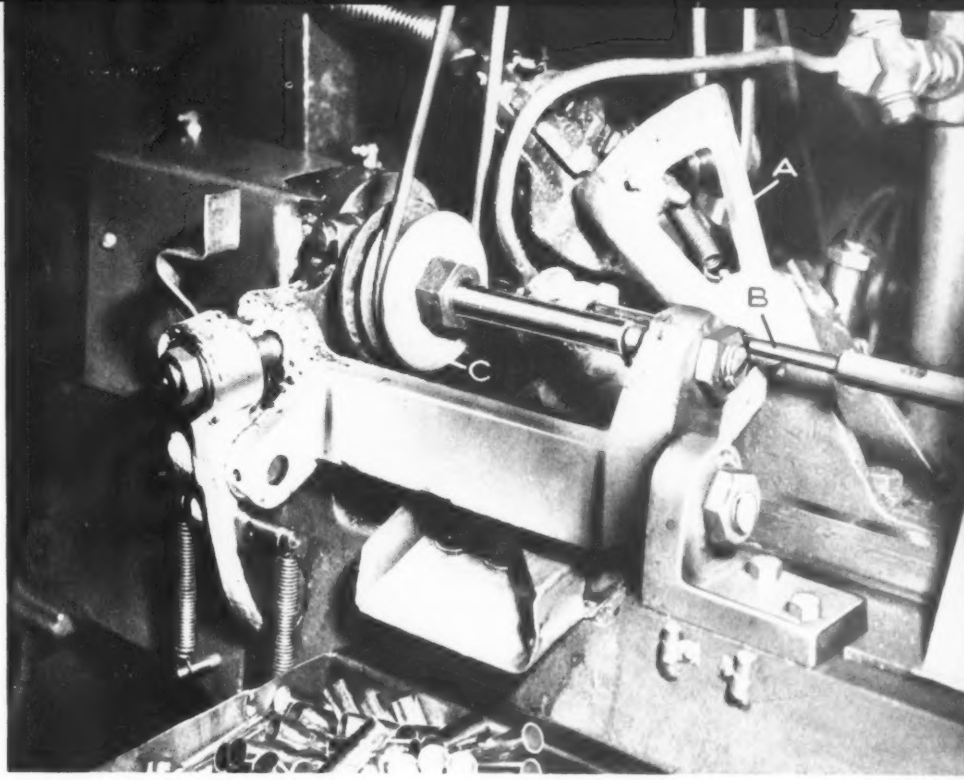


Fig. 16. Special Machine Used for Trimming Cartridge Cases to Uniform Length prior to the Final Drawing Operation. The Cases are Placed in the Cutting-off Position of This Machine by a Swinging Arm and a Feeding Stem

only difference being that three punches are employed on a press instead of four. The dies are of the same construction, there being upper and lower die members and a suitable stripper.

From the third draw the cases go to another washing and drying operation performed by a Colt Autosan machine on the mezzanine floor, and then are returned automatically to a trimming operation on the first floor. Trimming is performed in horizontal-spindle machines built by the Peters Engineering Co., Philadelphia, Pa., which employ a rotary cutter. The object of this preliminary trimming operation is to remove the uneven open end of the cases and bring them all to uniform length for the fourth and final draw.

From the hopper of the trimming machine the cases are fed through a flexible tube to an oscillating arm *A*, Fig. 16, which selects and brings the cases, one at a time, into position for being picked up by a horizontally actuated feeding stem *B*. This stem pushes the open end of the case on a rapidly revolving spindle, and holds it in position while a cam-actuated circular cutter *C* is advanced against the case from the front of the machine to cut off the surplus length. If

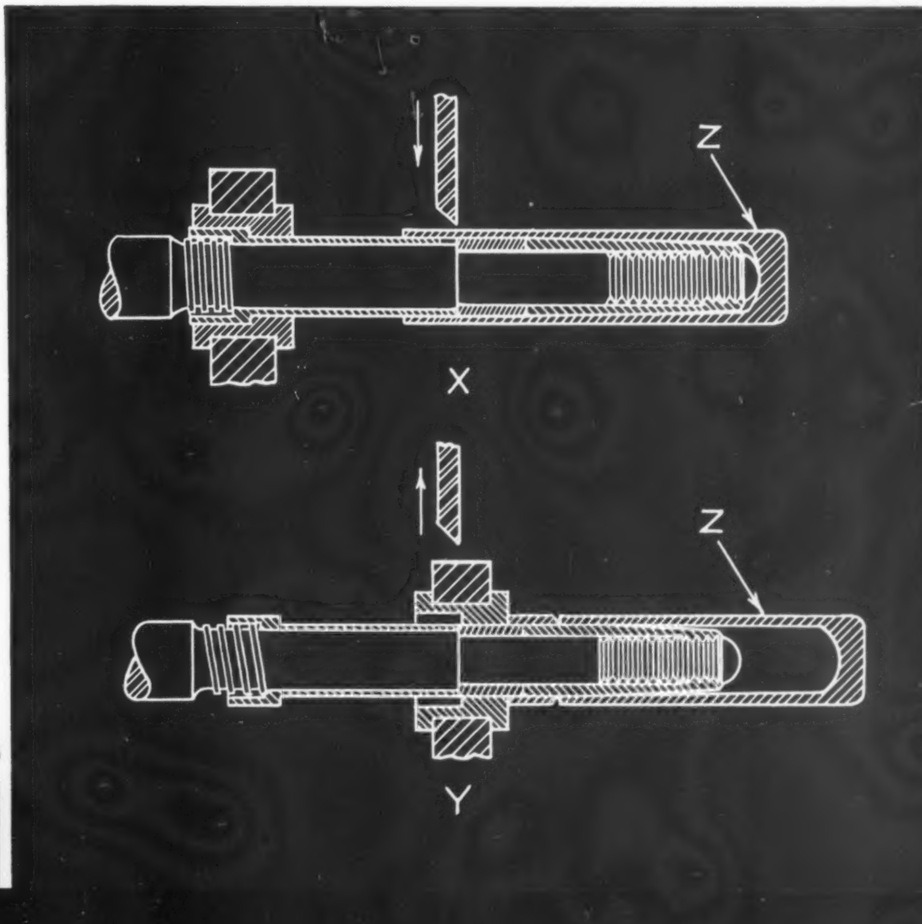


Fig. 17. Diagrams Illustrating the Manner of Holding the Cartridge Cases on the Spindle of the Trimming Machines and of Stripping the Trimmed Cases from the Spindle

any oil or lubricant remained inside the case from the preceding drawing operation, the case would not rotate with the spindle of the trimming machine, and would be stripped off when the machine cycle was completed with the scrap portion still intact. This is one reason why all cases must be clean before trimming.

When the trimming cutter returns to its normal position, a sliding arm pushes the case and the trimmed scrap from the spindle. The case drops into a chute that leads to a batch box, while the scrap is blown into a separate container by a blast of compressed air.

The manner of supporting the case during trimming is shown diagrammatically at *X*, Fig. 17, and the method of stripping off the trimmed case at *Y*. The cartridge case is indicated at *Z*. When the cases enter the hopper of the trimming machine, they are approximately 2 inches long; after the operation, they have a length of 1 23/32 inches.

When the trimmed cases reach the mezzanine floor, they are dropped on a wide, slowly moving conveyor belt, and as they move along they are visually inspected to make certain that no untrimmed scrap accompanies the cases and that there are no untrimmed cases. Either condition could cause severe damage to tools in the fourth drawing operation.

The cases are then passed through annealing, pickling, washing, lubricating, and drying operations for a third time, all of which are performed automatically by equipment of the same type as used after the first draw. The cases are then delivered by chutes to hoppers of Bliss vertical single-crank presses similar to those used for the second and third draws, with the exception that there are only two punches on each machine. It is in this operation that the wall of the cartridge cases reaches its final thickness, and, therefore, great care is always taken to see that the punches and dies are of the proper size and closely aligned.

At this point an inspector carefully checks the base thickness of the cartridge cases by using a dial gage, determines the diameter by means of "Go" and "Not Go" ring gages, and inspects the wall thickness by applying a dial gage with the cartridge case slipped on a spindle. This inspection is, of course, performed only on a small percentage of cases.

From the fourth drawing operation the cartridge cases return to the upper floor for washing and drying in a Colt Autosan machine. The cases then pass on to Peters trimming machines for a second trimming operation, after which they are carried to Bliss machines similar to the one illustrated in Fig. 12 for roughly forming the primer pocket, as shown in the fourth diagram from the right in Fig. 3, page 139.

Immediately afterward, machines of the same type are employed to head the base end, as indicated in the next diagram of Fig. 3. In this operation, the primer pocket is resized and the head is formed to a somewhat larger diameter than the case proper. This cold-working method of forming the cartridge-case head gives it the high degree of hardness desired. It is not softened or annealed in any succeeding operation.

From the heading machines the cases go to

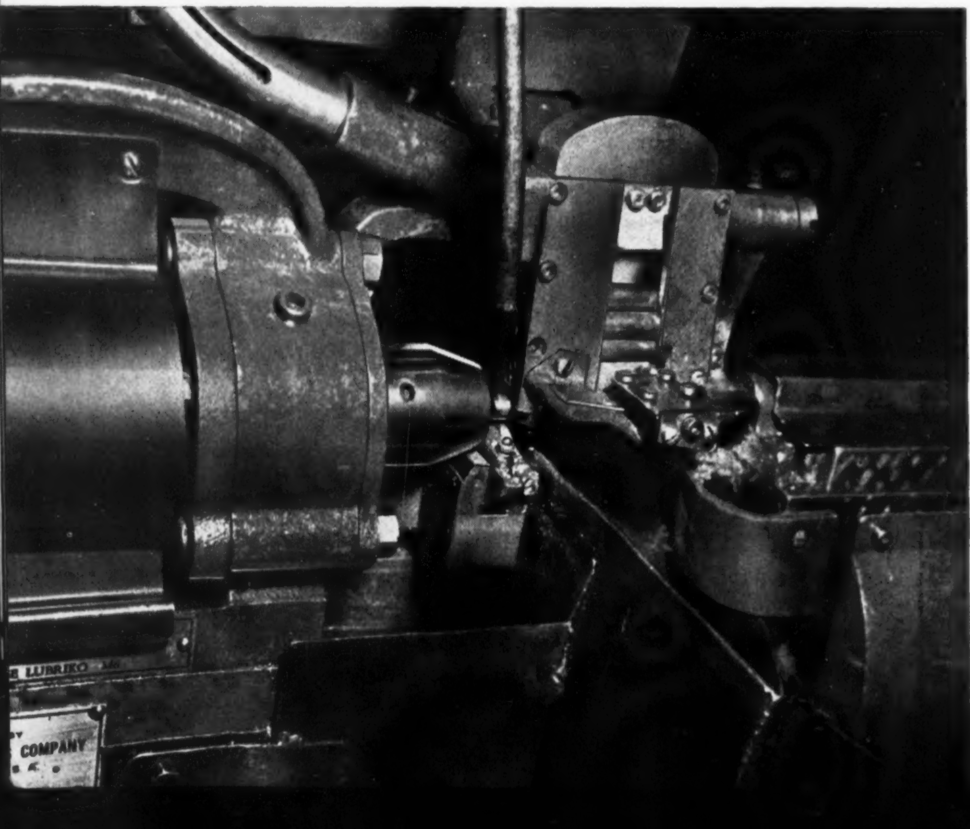


Fig. 18. After being Headed on "Bumping" Machines, the Cartridge Cases are Turned on the Base End by a Form Tool on Machines of the Type Here Shown

another washing and drying operation on the floor above, which is again performed in a Colt Autosan machine. They are then returned to hopper-fed horizontal-spindle machines on the first floor, built by the Owens Illinois Glass Co. for turning the head end. One of these machines is seen in Fig. 18. The cases are delivered through a flexible tube to a feeder magazine, which drops them, one at a time, into the path of a reciprocating injector stem that moves the case toward a collet on the headstock end of the machine. In this movement, the case encounters the blunt end of a knock-out rod in the center of the collet, which recedes into the spindle against the action of a coil spring as the case is pushed into place.

During the last 1/4 inch of the injector stroke, the collet begins to close, exerting sufficient pressure on the case to hold it at the exact point that it should reach upon the completion of the injector stroke. At the forward end of the injector stem there is a hardened revolving disk which rotates the case and assists its entry into the collet.

When a case has been loaded into the collet in the manner outlined, a forming tool on a small cross-slide advances toward the front of the machine and turns a groove to the proper depth in the base end of the cartridge case, cuts a taper at one side of the groove to the specified angle, and turns the head to the required diameter. All of these cuts are taken within exceptionally close tolerances. At the end of the operation, the case is automatically ejected from the collet. Compressed air blows the chips away from the form tool and keeps the tool cool, thus greatly prolonging the life of its cutting edge. It is important that the form tool be kept sharp, because a dull cutter will leave burrs on the heads of the cases and cause the rejection of cartridges during final gaging and weighing.

The trimmed cases next go to the mezzanine floor, where they are fed into chutes which lead to body annealing machines designed as illustrated in Fig. 19. There are two small conveyor screws for feeding the cases in two rows in opposite directions from hoppers at both ends of the machine. As the cases move along, the head ends are submerged in a trough of water to keep them hard, while the bodies move through a series of open gas flames directed from jets in pipes that extend horizontally along the front and back of the machine. As the screws move the cases along they also revolve them to insure uniform annealing around the entire body.

This operation prepares the cases for tapering the open end, and is essential, as unannealed cases would wrinkle and split near the open end. Too high an annealing temperature, however, would cause just as disastrous results, and so the temperature must be closely controlled. These machines were also built by the Peters Engineering Co. At the end of the operation, when the cases are discharged onto a belt conveyor, the annealed portion is discolored to a certain point known as the "transformation" point, which must be within a specified distance from the mouth of the case.

The cases now go again to the mezzanine floor for a lubricating operation, which is performed

Fig. 19. The Body of the Cartridge Cases is Annealed as the Cases are Carried through Gas Flames with the Hard Base End Submerged in Water

In Station 2, there is a "mouth-ironing" punch which removes any small irregularities in the mouth of a case and thus prevents folds and creases. In Station 3, the cases are worked upon by an overhead die which forms the taper and shoulder about 50 per cent. A plunger stem here enters the case to hold it securely as the die descends and to assist in forming the taper and shoulder. The stem also acts as a stripper to remove the case when the die returns upward.

In Station 4, there are a die and a plunger

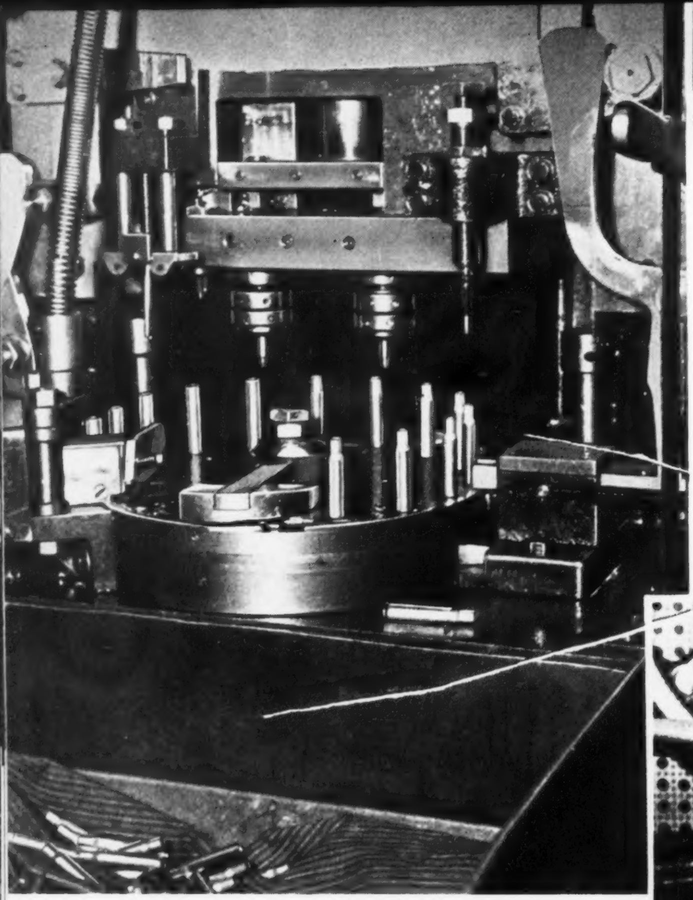


Fig. 20. Press Equipped with a Rotary Dial that Successively Indexes Cartridge Cases to Various Stations for Forming the Taper and Shoulder at the Mouth End

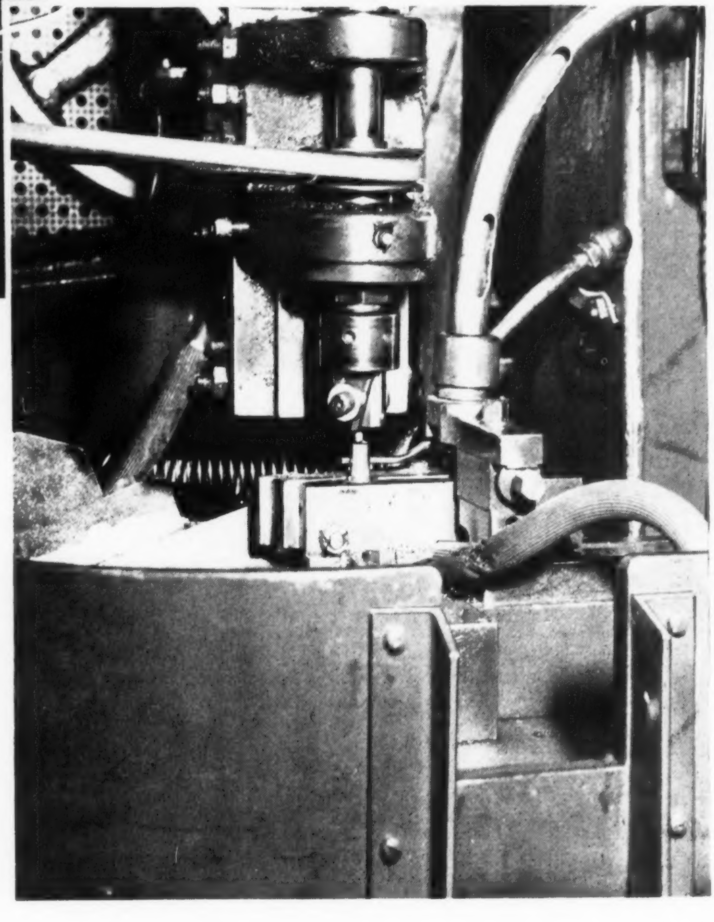


Fig. 21. Type of Machine Employed for Trimming Mouth End of Cartridge Cases to the Specified Final Length

in a Colt Autosan machine filled with a solution consisting of 16 pounds of Lubatube to 140 gallons of water. The lubricated cases are then delivered to chutes which lead to the hoppers of Bliss double-action presses, equipped, as shown in Fig. 20, with a rotary dial that carries the cases in succession to several operating stations. In Station 1, the cases are located beneath a finger that acts both as a detector for deformed or inclined cases and also as a lubricator for the inside of the case. If this finger strikes an obstruction upon the descent of the ram, the clutch will be disengaged and the machine stopped.

similar to those in Station 3, which complete the formation of the taper and shoulder. Finally, in Station 5 a second "mouth-ironing" punch enters the open end of the case and advances the full length of the neck for smoothing and rounding this portion of the case. Oil fed to this punch in drops from a reservoir enables this sizing operation to be freely accomplished. To prevent the case-holding plate from being lifted from the dial when the punch is pulled out of the case, a horizontally actuated stripper bar, seen at the right in the illustration, advances into contact with the case and holds it down

when the punch ascends. As each finished case reaches the front side of the dial it is ejected from the machine by a knock-out bar of curved contour and discharged into a batch box.

All lubricant and foreign matter are removed from the cases by another Colt Autosan machine on the mezzanine floor, which is supplied with a cleaning solution of higher concentration than that used in preceding washing and drying operations, as it is absolutely essential that the cases be clean and dry for the next operation. This operation consists of a final trimming on vertical type machines built by the Fidelity Machine Co., Philadelphia, Pa., as shown in Fig. 21.

The cartridge cases fall from the hopper of the machine into a feed-tube that leads to a feed-block, from which they drop into a groove in a transfer slide. The cases are individually positioned vertically beneath a cutter-spindle head which descends to trim the case, the latter having been, in the meantime, gripped securely between stationary and sliding jaws. At this time, the transfer slide has receded to pick up the next case to be trimmed. The cutter somewhat resembles an inserted-blade end-mill. Just before the cutter blades engage the end of the cartridge case mouth, a small pilot in the center of the tool is inserted in the mouth to center and steady the case during the cut. When trimming has been completed, the cutter-head rises to its starting position and the trimmed case is ejected into a chute by the transfer slide as it brings the next case into the trimming position.

At the completion of this operation, the cases are again carried by a conveyor and elevator to

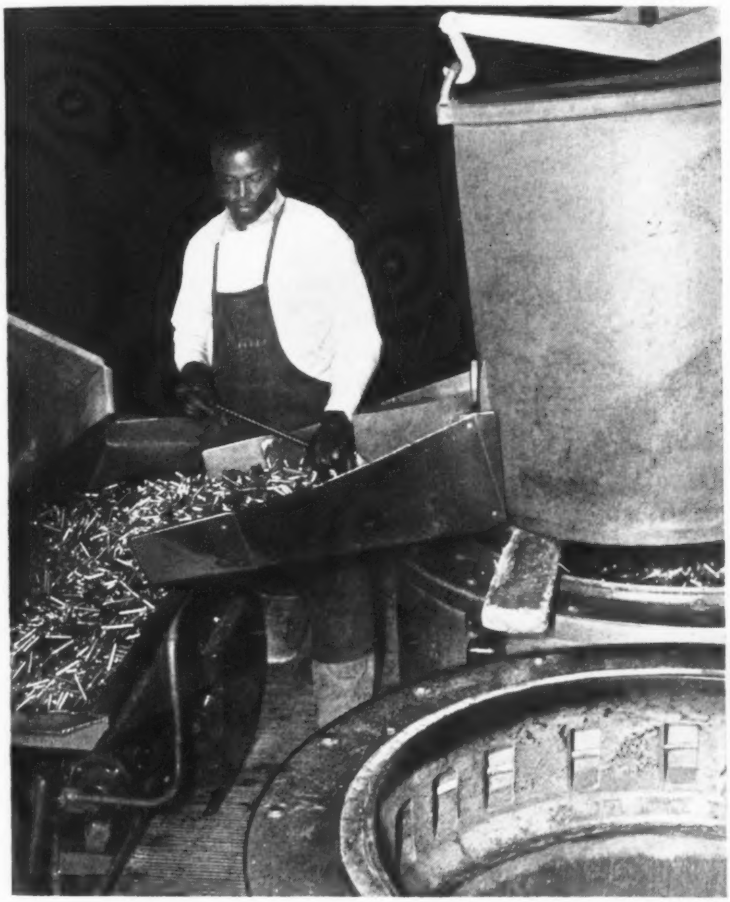
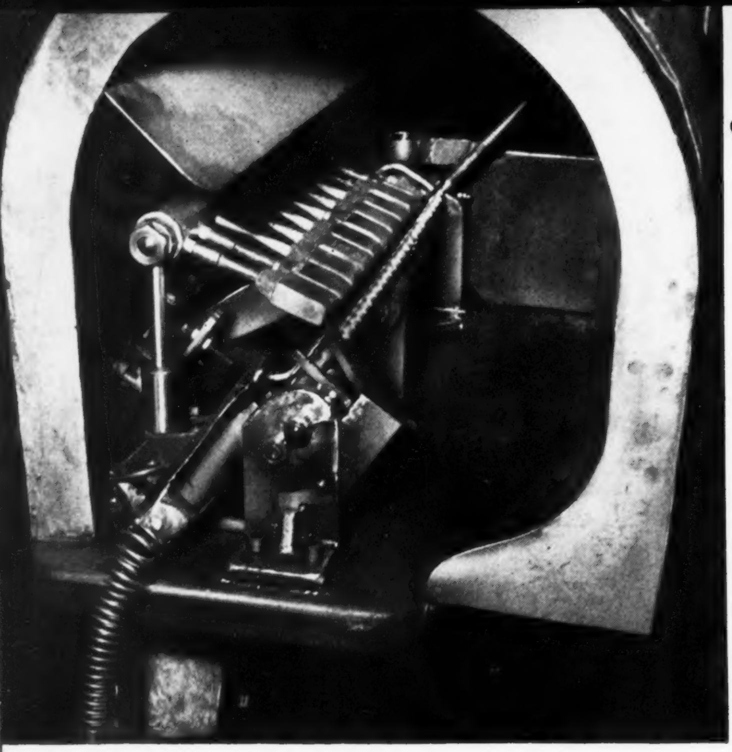


Fig. 22. The Cartridge Cases are Annealed for Stress Relief in Electric Furnaces after the Final Trimming Operation, and then Pass through Washing and Drying Equipment

Fig. 23. Two Rows of Mouth and Neck Annealing Machines with the Typical Pipe-like Chutes that Feed the Hoppers of Cartridge-making Machines



the mezzanine floor, where they are delivered to large hoppers adjacent to Lindberg electric annealing furnaces, two of which are seen at the right in Fig. 22. The cartridge cases are loaded into large, cylindrical baskets for the operation, one of these baskets being seen suspended from an overhead hoist just after having been removed from the furnace in the foreground. The cases are heated to about 450 degrees F.

During loading and unloading, the furnace temperature drops 150 to 175 degrees from the annealing temperature, and it takes about thirty minutes of gradual reheating to again obtain the stress relief temperature of 450 degrees F. The purpose of this operation is to relieve the cartridge cases of all strains that were set up in the operations following the third anneal. The work-holding baskets are made with a perforated bottom to enable the heat to rise uniformly throughout the charge.

During the operation, a sealed blower forces a draft over the furnace heating coils and circulates the heated air completely around the cases. At the end of the operation, the furnace cover is swung aside, the basket hoisted out of the furnace, and its contents emptied into a chute that leads to a Niagara washing machine, one end of which is seen in Fig. 22. The washing equipment removes any oxide formed during the stress relieving operation, being supplied with a dilute sulphuric acid solution. A fresh water rinse follows the acid bath.

When the cartridge cases leave the Niagara washing machine, they are passed through another Colt Autosan washing and drying machine, after which they are fed by chutes to the hopper of mouth and neck annealing machines, two rows of which are illustrated in Fig. 23. In these machines, two conveyor screws of opposite hand carry the cases past a series of gas flames emitted from units arranged as seen in Fig. 24.

These screws are mounted one above the other, with the axes in an inclined plane, as indicated in the illustration. The photograph was taken from the discharging end of a machine, where the cases drop from the screws into a chute that leads to a batch box. They are periodically dumped into another conveyor which leads to an elevator that carries them back to the mezzanine floor. This annealing operation softens the neck and mouth of the cartridge

Fig. 24. (Above) Close-up View of One of the Mouth and Neck Annealing Machines, Showing the Manner in which the Cartridge Cases Move Under Gas Flames

Fig. 25. (Left) The Cartridge Cases are Visually Inspected for Defects while Rotating past Girl Inspectors

Fig. 26. The Aging of Cartridge Cases, which Normally Takes Five Years, can be Induced in Five Minutes by a Mercury Solution, in Order to Determine whether Cracks will Develop in a Batch of Cases due to Insufficient Annealing

cases sufficiently to facilitate bullet assembly, and obviates cracking of the necks while the cartridges are in storage.

The hoppers on these annealing machines are of a "rathole" type used on a considerable number of machines in this plant. These hoppers are provided with a rotating paddle which lifts the cartridge cases onto a small belt that carries them forward over a throat, or "rathole," leading to a tube that feeds the machine. If a cartridge case approaches this hole with the heavy end first, the weight of this end will cause the case to fall into the hole with the head end downward, as desired. On the other hand, if the open end of the case reaches the hole first, this end will pass over the hole and the case cannot drop into the feed-tube. Instead, it will fall back into the hopper.

After the annealing operation, the cases are automatically fed to Fidelity machines of the type shown in Fig. 25 for a visual inspection. Here they are again revolved by twin screws as they move from left to right across a table under the watchful eyes of a girl inspector. Mirrors positioned above and below the pieces enable the inspector to observe defects on the inside and on the head end, as well as on the body and neck. Shells with dents or other marks are quickly flipped from the machine into scrap boxes by the deft fingers of the inspector. A counter at the right-hand end of the machine automatically records the number of cartridge cases that pass inspection.

Experience has shown that insufficiently annealed cartridge cases, after a period of from three to five years, will burst when fired, and sometimes even while standing in storage. The time elapsed between the date of manufacture and such an occurrence depends upon the magnitude of unrelieved stresses in the cases. Cracks usually occur at the mouths and shoulders, and run longitudinally along a case, but occasionally a case will be found with concentric cracks.

To check on the quality of the annealing, use is made of a mercury cracking test. Cartridge cases with scrap bullets assembled are used for this test. They are first submerged for thirty seconds in a 40 per cent solution of nitric acid to clean them thoroughly, and then washed in water. Next they are submerged in a solution of 1 per cent mercurous nitrate and 1 per cent nitric acid for a period of fifteen minutes. After this, the cartridges are washed and carefully observed for cracks. Cartridges that have been in the solution for only five minutes are aged an amount equivalent to an aging of five years under normal conditions. This mercury cracking test is performed on cartridges after the Lindberg annealing operation, and also after the mouth and neck anneals, and after priming. The bullets are inserted in the cases by the use of a hand press. Fig. 26 shows a corner of the laboratory in which the test is performed.

Another installment of this article, which will appear in May MACHINERY, will describe the methods used in producing the cartridge jackets; the assembling of the cores, jackets, and cases; the manufacture of the primers; loading the bullets and powder into the cases; and final inspection of the assembled cartridges.

Millions of 155-Millimeter Shells

Forging, Heat-Treating, and Machining 155-Millimeter High-Explosive Artillery Shells by Mass Production Methods that have Become Recognized as Preferred Practice

By JOSEPH W. FRAZER
President and General Manager
Willys-Overland Motors, Inc.

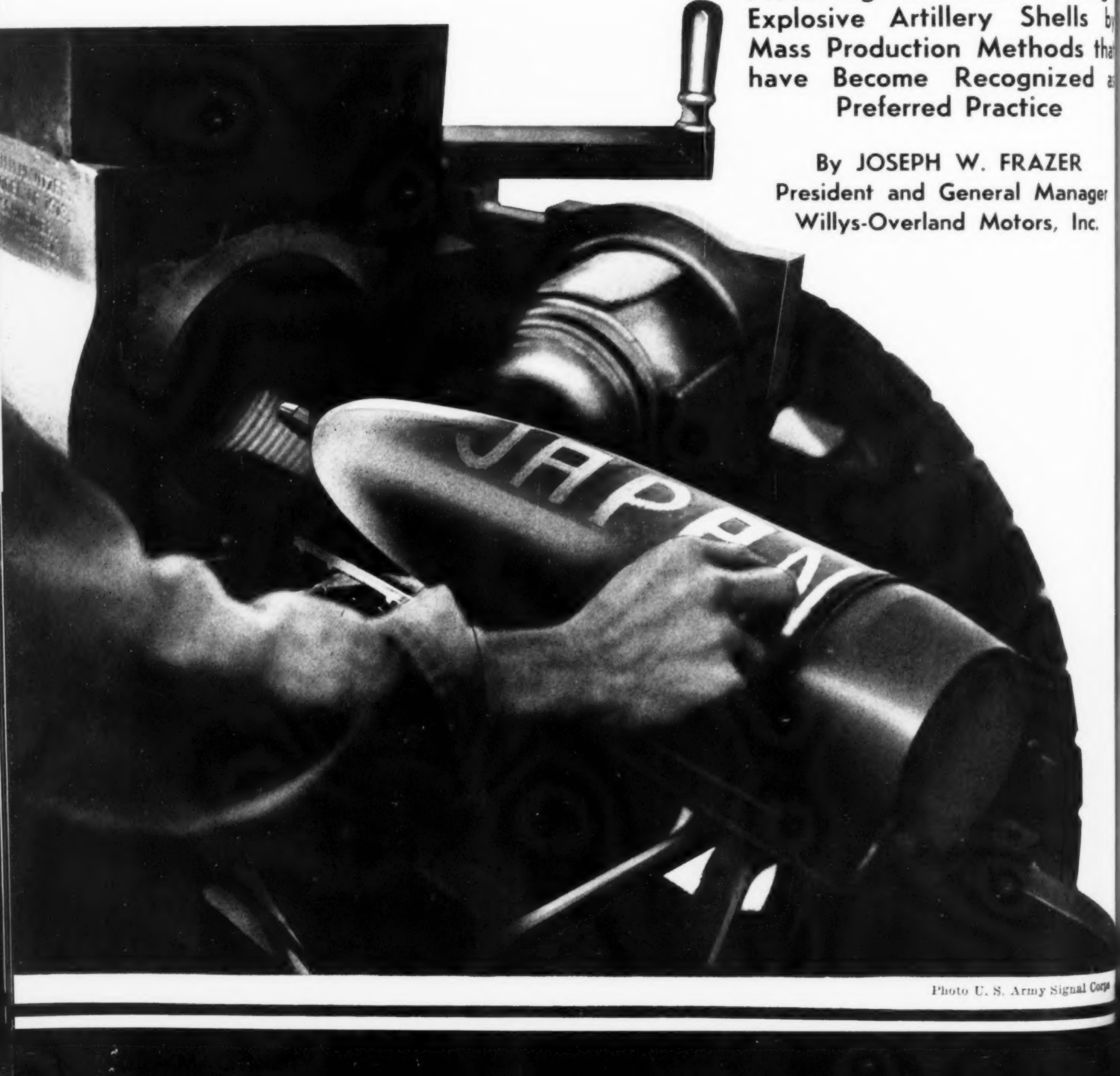


Photo U. S. Army Signal Corps

BY WILLYS-OVERLAND PRODUCTION METHODS

THE speed with which American industry changed over from the manufacture of peacetime products to turning out the weapons of warfare will always be an amazing chapter in our history. The uninformed have occasionally wondered why months passed by before a concern started the delivery of guns, shells, tanks, or ships after orders had been placed; they did not realize the vast amount of production planning necessary for each job or the time required to obtain suitable machine tools and equip them with special tooling to meet individual requirements.

Two years ago—in March, 1941—Willys-Overland Motors, Inc., was given an order for the manufacture of 155-millimeter high-explosive artillery shells. These shells were to be forged with a cavity so accurate that no inside machining would be necessary, although up to that time no shells larger than 90 millimeters in diameter had been forged in this country. Also, there had been no experience for over twenty years in the manufacture of large shells, and the 155-millimeter shells had been redesigned since the first World War. Little was known as to the best production methods to be adopted. Complete shell forging and machining equipment had to be planned, built, and tooled up.

In spite of the great amount of engineering work involved and the delays necessitated by experimentation, obtaining equipment, and redesigning machines that were supplied for shell finishing, 12,000 shells were shipped from the Willys-Overland plant on June 26, 1941, slightly more than three months from the date when the order was received. Today, two years after the receipt of the original order, several millions of these shells have been sent to battle fronts. The manufacturing methods developed here have virtually been adopted as standard practice, and the plant is, therefore, the clearing house for information on the best methods of manufacturing 155-millimeter shells.

Incidentally, these shells are used with sep-

Fig. 1. Diagram of a 155-millimeter Shell, Such as is Manufactured in the Willys-Overland Plant, together with the Propelling Charge and Igniter

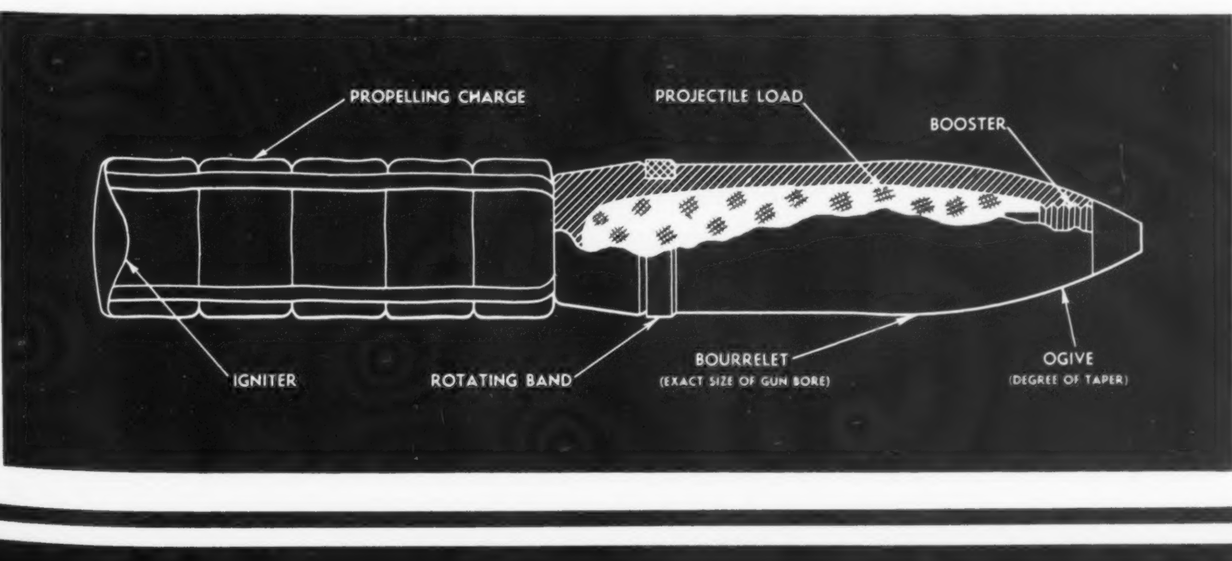


Fig. 2. Loading a Billet from which a 155-millimeter Shell will be Produced into a Furnace for Heating prior to Forging

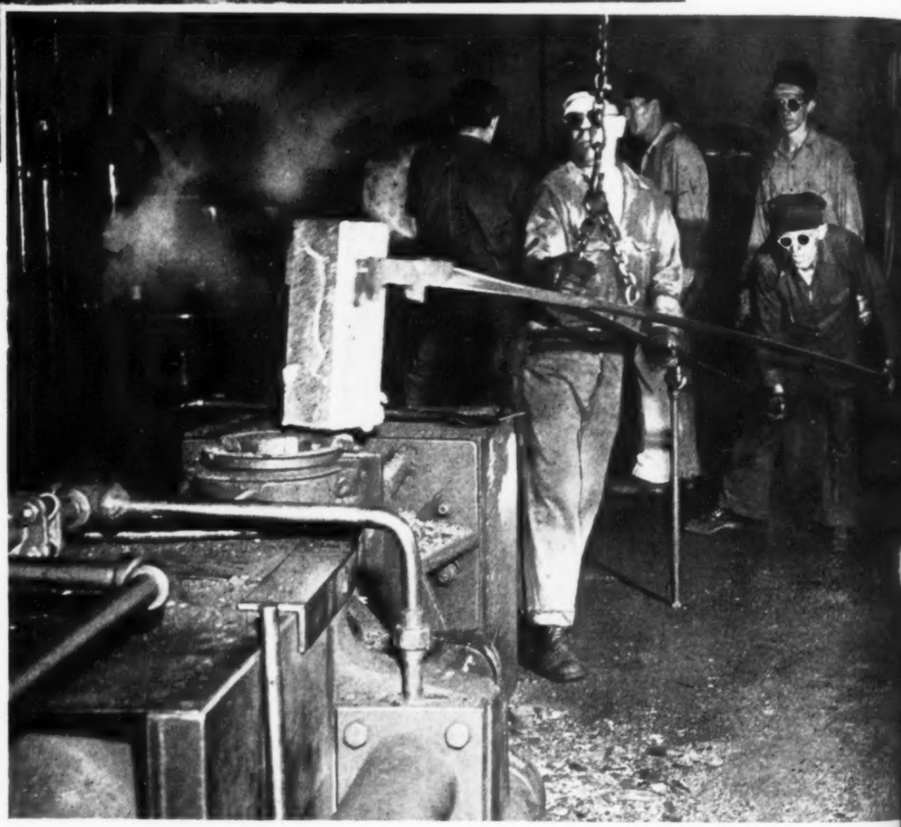


Fig. 3. Placing a Heated Billet in the Descaling Machine prior to Performing the Piercing Operation

arately loaded ammunition; the projectile, propelling charge of powder bags, and primer are loaded separately into the breech of the gun, since one of these shells with an attached cartridge case loaded with the propelling charge would be too heavy to handle on the firing line. A diagram of one of these shells with its separate propelling charge and igniter is shown in Fig. 1.

One of the outstanding features of shell production in the Willys-Overland plant is the extensive use of conveyors for carrying the shells from department to department, from one operation to another, and through heat-treating and washing operations. There are 6300 linear feet of overhead conveyors and 5000 feet of roller gravity conveyors.

Production starts in the forge shop, where steel billets of the specified analysis, cut to the required length, are received from the steel mills. These billets are 5 1/2 by 5 1/2 inches in cross-section, and 15 1/2 inches long. They weigh between 130 and 134 pounds. The billet cross-section is square with slightly rounded corners.

The billets are loaded into gas-fired Surface Combustion rotary furnaces built with slowly revolving beds, 23 feet in hearth diameter. The

beds are large enough to accommodate 150 billets at a time, laid horizontally. The furnaces are operated at a temperature of approximately 2300 degrees F., and each billet remains in the furnace for two hours.

Tongs supported by an overhead hoist, as shown in Fig. 2, facilitate the loading and unloading of the billets. Immediately upon the removal of a heated billet from the furnace, it is placed vertically in a descaling machine, as illustrated in Fig. 3, and squeezed between two jaws in such a way as to loosen all scale. Any scale that does not drop from the billet is scraped off.

While still hot, the billet is transferred to an Elmes 500-ton hydraulic piercing press of vertical design. This press is equipped with two piercing mandrels mounted on a slide that is moved alternately from left to right and from right to left between operations to prevent the mandrels from becoming too hot. One of these mandrels can be seen in Fig. 4 to the right of the shell forging. In an operation, the hot billet is dropped into a pot type die and one of the mandrels is shifted into position directly above the die. The mandrel is then brought down under hydraulic pressure to pierce a hole almost the full length of the billet. Before the mandrel comes in contact with the billet, however, a head equipped with a sleeve for guiding the mandrel comes down with the press ram into a position close to the top of the die.

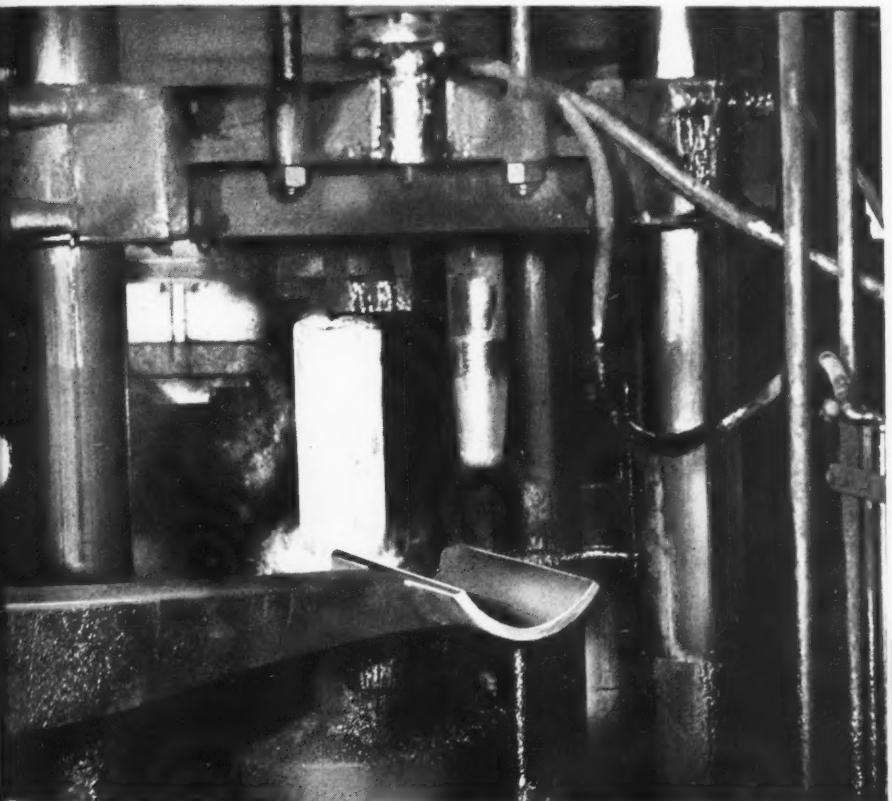


Fig. 4. The Heated Billets are Pierced and Shaped to a Cylindrical Outside Diameter by the Use of a 500-ton Hydraulic Press

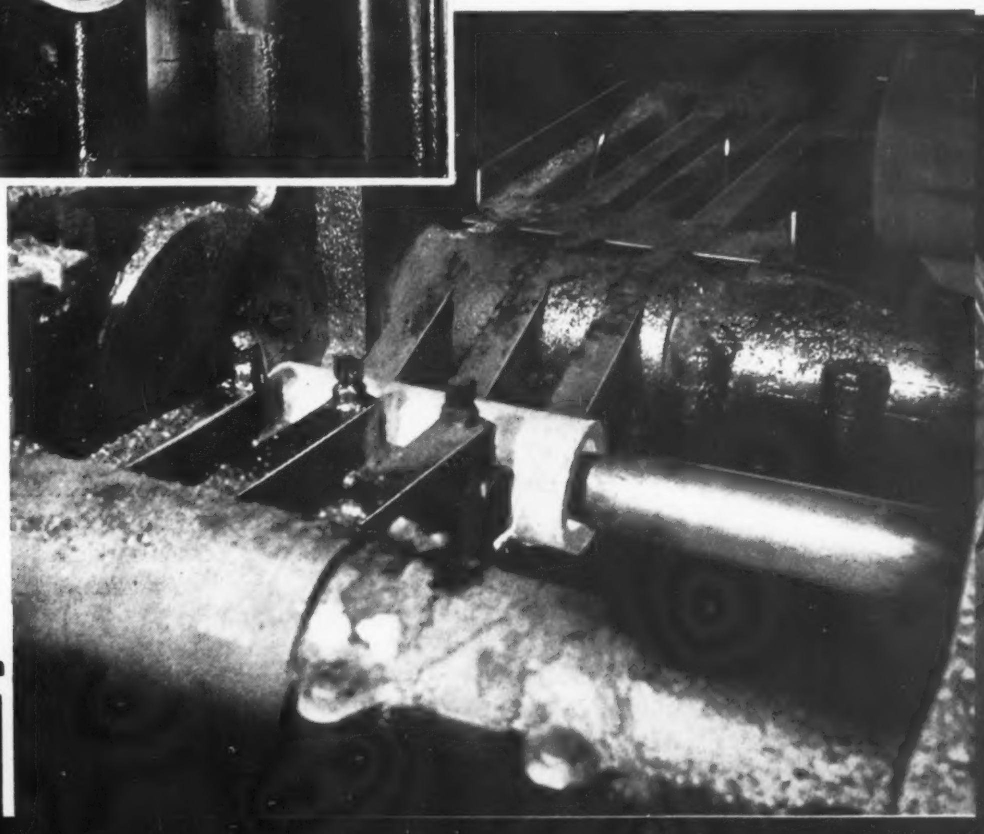


Fig. 5. After the Piercing Operation, the Shells are Transferred to a Draw-bench in which a Mandrel Pushes Them through Six Die Rings for Sizing

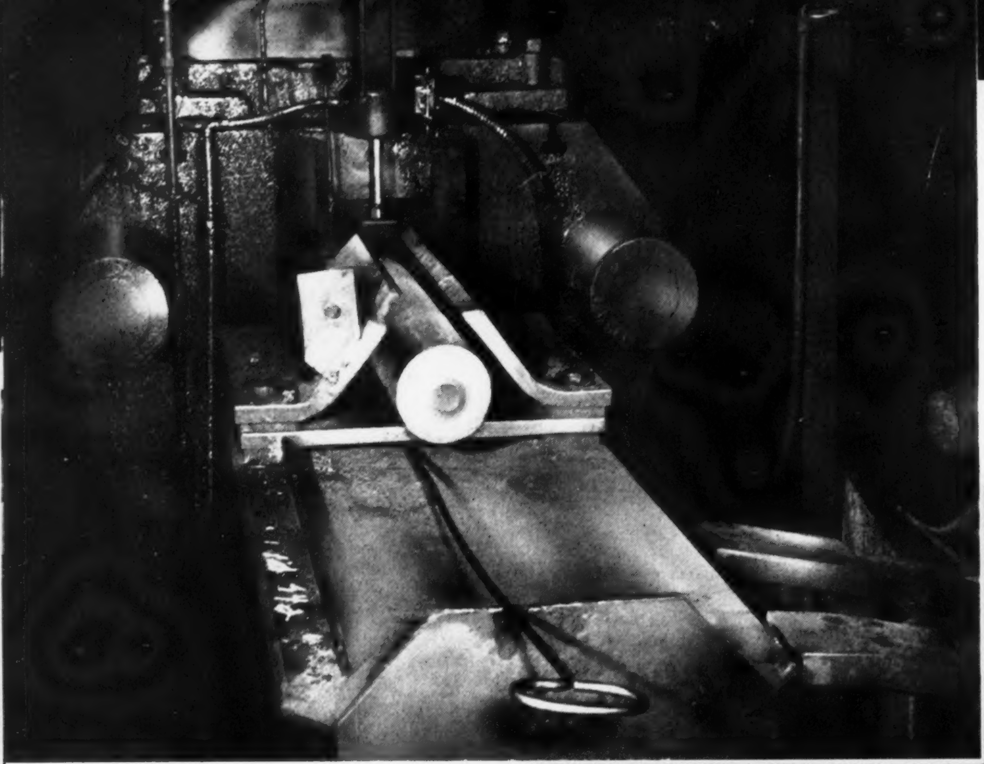


Fig. 6. Discharge End of the Draw-bench, where a Vertical Slide Strips the Shell from the Returning Mandrel

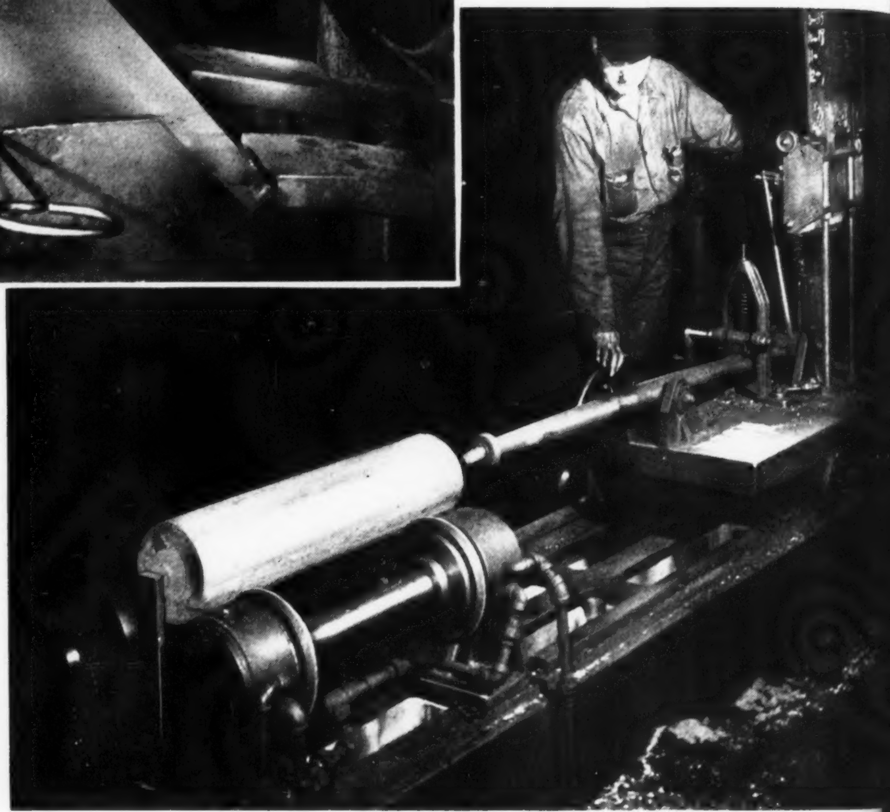


Fig. 7. The Concentricity of the Shell Cavity with the Outside Surface is Inspected on a Machine Equipped with an Automatic Recording Device

When the mandrel returns upward, an ejecting device at the bottom of the die lifts the pierced forging into the position shown. In the meantime, the end of a long arm which is pivoted on a stand about midway between the piercing press and an Elmes 250-ton draw-bench, used for the next operation, has been swung into position at the back of the piercing press, as seen in the illustration. The press helper tips the shell forging over with his tongs, so that it falls on the shelf-like end of the swinging arm. The arm then swings through about 270 degrees to carry the shell to the draw-bench.

When the forging comes from the piercing operation, it has a length of approximately 19 inches, and the cavity is about 4 7/8 inches in diameter by 17 inches in depth. The slide to which the piercing mandrels are attached also carries a stripper plate that prevents the shells from adhering to the mandrels with the upward strokes of the ram.

The draw-benches used for the next forging operation are of horizontal design and have a hydraulically actuated ram which carries a mandrel at its forward end, as seen in Fig. 5. This mandrel is inserted in the pierced shell with the forward stroke of the ram, and pushes the shell through a series of six ring dies, which are progressively smaller in diameter. These dies gradually reduce the shells to the desired diameter and increase their length, so that at the end of the operation, the shells are approximately 28 inches long by 6.4 inches outside diameter, and have a cavity 25 inches deep by 4 7/8 inches in diameter. The stroke of the draw-bench ram is 10 feet, and the die rings are about 3 1/2 inches wide.

As each shell is pushed out of the draw-bench

to the position seen in Fig. 6, a vertical stripper plate falls down behind the shell and forces it from the mandrel when the latter starts upon its return stroke. Each shell is then stamped with its heat number. After being stamped, the shells roll down a short chute to a chain conveyor provided with cradles that carry two shells at a time. This conveyor carries the shells back and forth in long parallel lines for cooling purposes, and then out of the forge shop to a shot-blasting operation in another building. The conveyor is 4200 feet long.

Every fifteen minutes, one of the shells from the piercing presses is placed on a machine such as shown in Fig. 7 for determining the concentricity of the cavity with the cylindrical outside surface. While the shell is slowly turned on motor-driven rolls, a much smaller roller, attached to the end of a long mandrel, is gradually fed the length of the cavity. The mandrel is mounted on a carriage having wheels which run on tracks on the bed. During the inspection, a graph indicating the degree of concentricity is automatically drawn by pencil on a chart at the operator's end of the machine.

The forge shop has a number of set-ups such as described—that is, completely individual units, each of which comprises a rotary billet

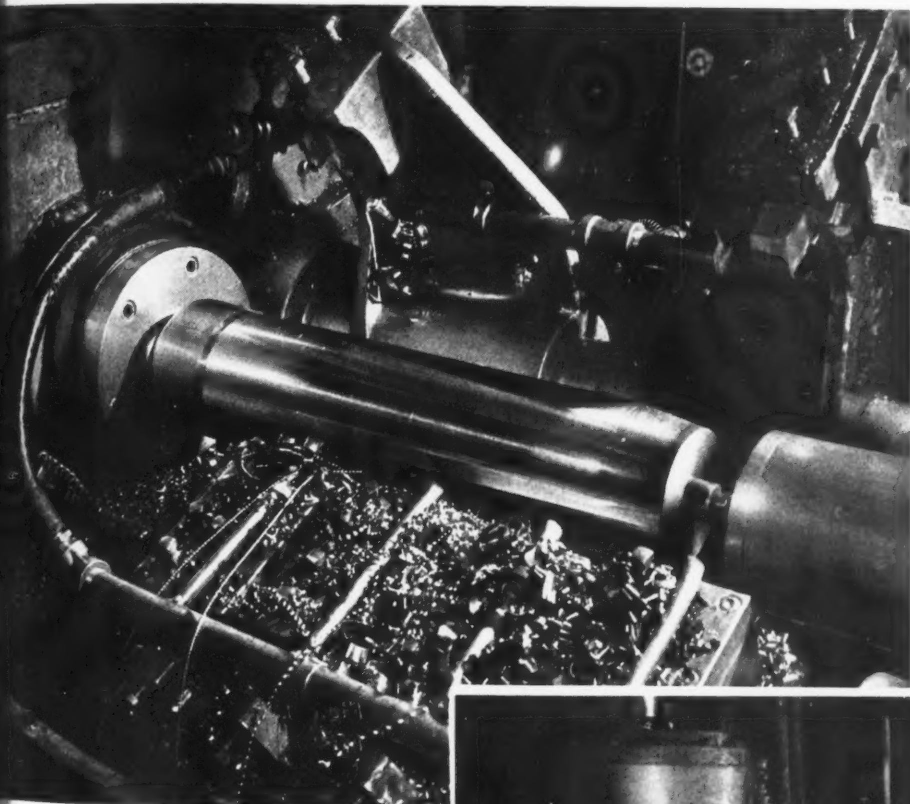


Fig. 8. Arrangement of the Tooling on a Curtis Automatic Lathe Used for Rough-turning and Facing the Shells

Fig. 9. On the Hepburn Lathes, the Rough-turning Tools are Mounted on a Back Carriage and the Facing Tools on Overhead Slides

heating furnace, a descaling machine, a piercing press, a draw-bench, and a concentricity checking machine.

When the long conveyor delivers the cooled forgings to the shot-blasting department, they are first sorted into heat and lot numbers. Then the shells are placed on a gravity conveyor which carries them to Pangborn twin shot-blasting machines by which they are shot-blasted internally. They are transferred from the conveyor to the shot-blast machines by overhead hoists. The time required for the blasting operation is contingent upon the condition of the shell cavity. When the shot-blasting operation is completed, the shell forgings are run to the rear of the machines on sloping conveyors for inspection. Rejected forgings are returned for reblasting, while those that pass the inspection are placed on an overhead conveyor which carries them to the machine shop.

The first machining operation consists of centering the base end on LeMaire vertical type machines, as shown in Fig. 10. The forging is slipped over a vertical tapered mandrel, equipped with expanding jaws near the top and bottom for gripping the shell in the cavity and revolving the forging. A centering tool attached to the spindle of a sliding head which is mounted on a short cross-rail is then centered above the work, and fed into the base end of the shell to produce a center hole for subsequent machining operations. As the spindle head can be withdrawn sideways from the working position between operations, only a short vertical movement of the spindle is required, and reloading of work is correspondingly speeded up.

Rough-turning, which is the next operation on the shell forgings, is performed on either of two types of automatic lathes—Curtis and Hepburn. Thirty-seven pounds of stock are removed in 2 1/2 minutes by either type of machine through the use of carbide-tipped tools. The depth of cut varies from 1/8 to 3/4 inch; the feed is 0.015 inch and the cutting speed is approximately 245 feet a minute.

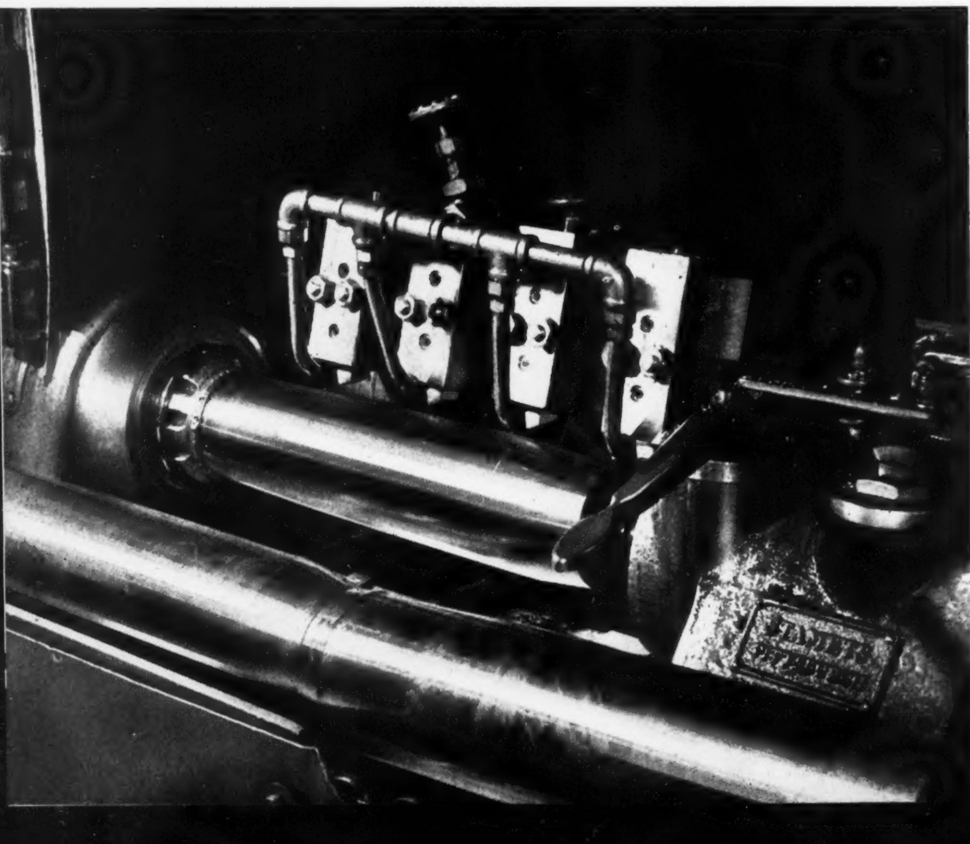


Fig. 10. (Above) The First Operation in the Machine Shop Consists of Centering the Base End for Supporting the Shell while Turning

Fig. 11. (Left) Tool Set-up for a Semi Finish-turning Operation on a Stamets Automatic Lathe

A view of this rough-turning operation on a Curtis machine is illustrated in Fig. 8, from which it will be seen that the machine is constructed with a tool-slide at the front. This slide, mounted on an arm, rocks toward the center of the machine for feeding the four tools to the work. It then moves longitudinally for taking the turning cuts. Three of the cutters move in a straight path, while the fourth is fed radially away from the center of the work as it travels from right to left, so as to turn the boat-tail to the required taper. This movement is effected as the tool-block moves along a cam-bar.

Two tools mounted on brackets at the rear of the machine are rocked forward to face the base or closed end of the shell forging and to cut off a ring about 2 inches wide from the open end. The open end of the forging is held on a plug attached to the headstock spindle, while the base end is supported on a tailstock center. The tailstock spindle is air-operated to permit quick loading and unloading of shells.

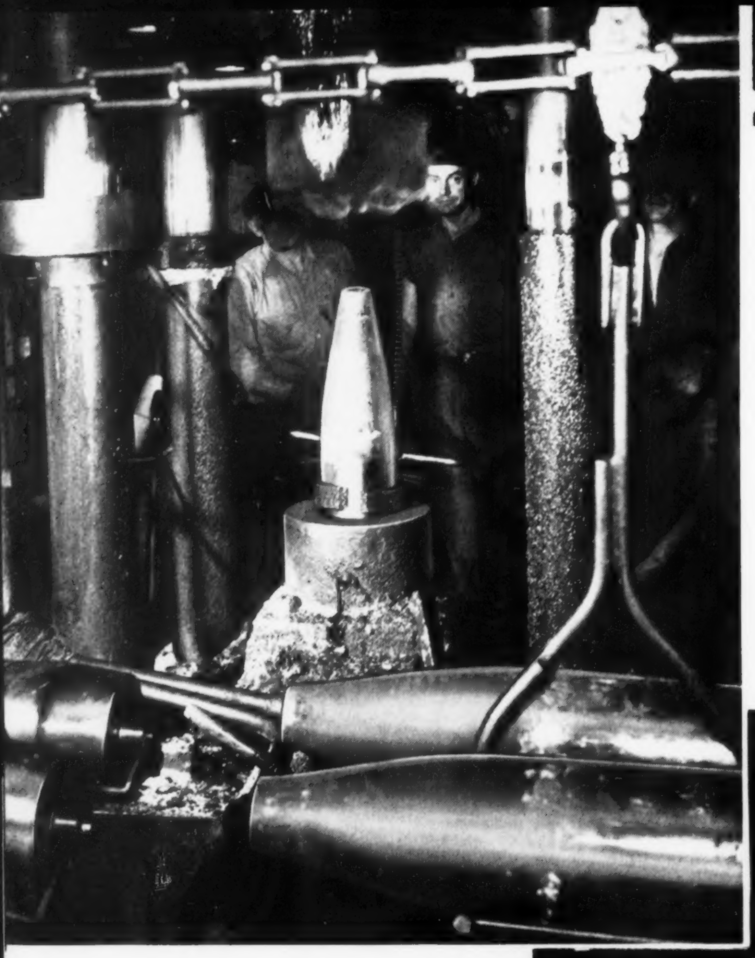
In Fig. 9 is shown a Hepburn automatic lathe set up for the same operation. This machine is equipped with a tool-slide in the back that carries five cam-controlled tools for turning the shell to the desired contour, and with two overhead hydraulically operated tool-slides that carry tools for facing the base end and cutting off the open end to length. Again, the carriage on which the turning tools are mounted is moved longitudinally. The facing tools are fed straight down. The tailstock of this machine, also, is air-actuated.

The shell forgings are next semi finish-turned, either on Hepburn machines or on Stamets automatic lathes. The Hepburn machines are similar to the one shown in Fig. 9, except that there are no overhead facing tools.

One of the Stamets machines is shown in Fig. 11. The turning cuts are taken by four tools mounted on arms at the back of the machine. These arms are individually operated to and from the work by cams as the tools are fed along the shell forging. From 12 to 15 pounds

Fig. 12. (Above) The Amount that Shells are to be "Nosed in" Depends upon the Diameter of the Cavity, which is Checked as Shown

Fig. 13. (Right) Salt Bath Furnace of the Type Used for Heating the Open End of Shells, Ready for Nosing



the shell by sliding the rod through a holder that is held stationary. Graduations along the sliding rod are observed with respect to a scribed line on the holder after the gage fingers have been expanded. The graduations on the rod are marked in different colors, and in each inspection, the shell is marked to correspond with the color of the graduation on the rod that coincides with the scribed line on the holder.

The shells are segregated according to these colors, and then, in the "nosing" operation, which follows, more or less stock is closed in, depending upon the weight-gage reading. This inspection and method of correction have com-

Fig. 14. In the Nosing Operation, the Open End is Closed from an Outside Diameter of 6 Inches to a Diameter of About 2 5/8 Inches

Fig. 15. Thousands of Shells Enter Heat-treating Furnaces Six Abreast at the Beginning of a Heat-treating Process that Insures Machinability of the Shells and the Desired Physical Properties

of stock are removed in the semi finish-turning operation. Cutting speeds and feeds approximately the same as those used in roughing are employed in this operation.

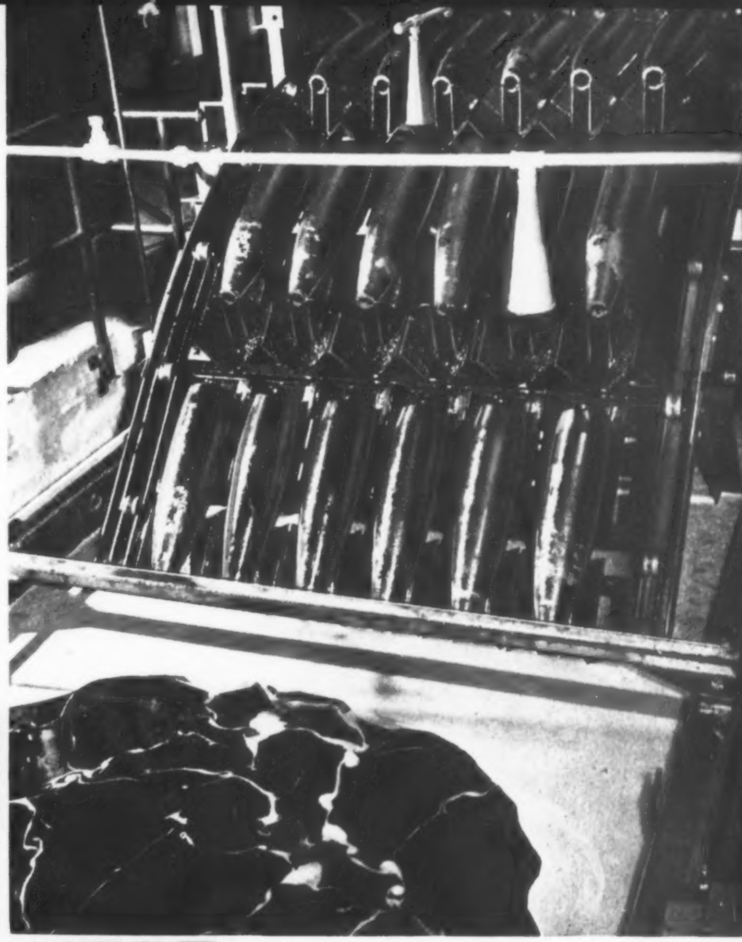
After semi finish-turning, the weight of each shell is checked with a gage that determines the diameter of the cavity. Since all shells are finish-turned to the same outside diameter, the size of the hole indicates whether they are light or heavy in comparison with the specified weight. This weight gage, as seen in Fig. 12, has three contact fingers arranged around a rod. The fingers are expanded against the inside wall of

pletely eliminated rejections for over or under weight. Gravity roller conveyors, such as seen in Figs. 11 and 12, are utilized to transfer the shells from operation to operation in the machine shop.

Immediately after the application of the weight gage, the shells are prepared for the nosing operation by immersing them in Ajax-Hultgren salt bath furnaces of the type shown in Fig. 13. Six shells can be placed vertically in a furnace at one time. They remain in the furnace until the open ends attain the required temperature. These furnaces are equipped with

electrodes that generate the heat directly within the salt bath. The electromagnetic forces produced cause a stirring action in the salt bath, which insures uniform heating of the shells. This type of furnace possesses also the advantage of enabling work to be heated locally to high temperatures in a relatively short time.

From the heating furnaces the shells are transferred by means of tongs supported from a hoist on an overhead crane to adjacent Watson-Stillman 350-ton hydraulic presses for the nosing operation (Fig. 14). In this operation, the open end is closed from a diameter of over 6 inches to a diameter of approximately 2 5/8 inches. The shell is subjected to the nosing operation for a length of approximately 12 inches from the open end.



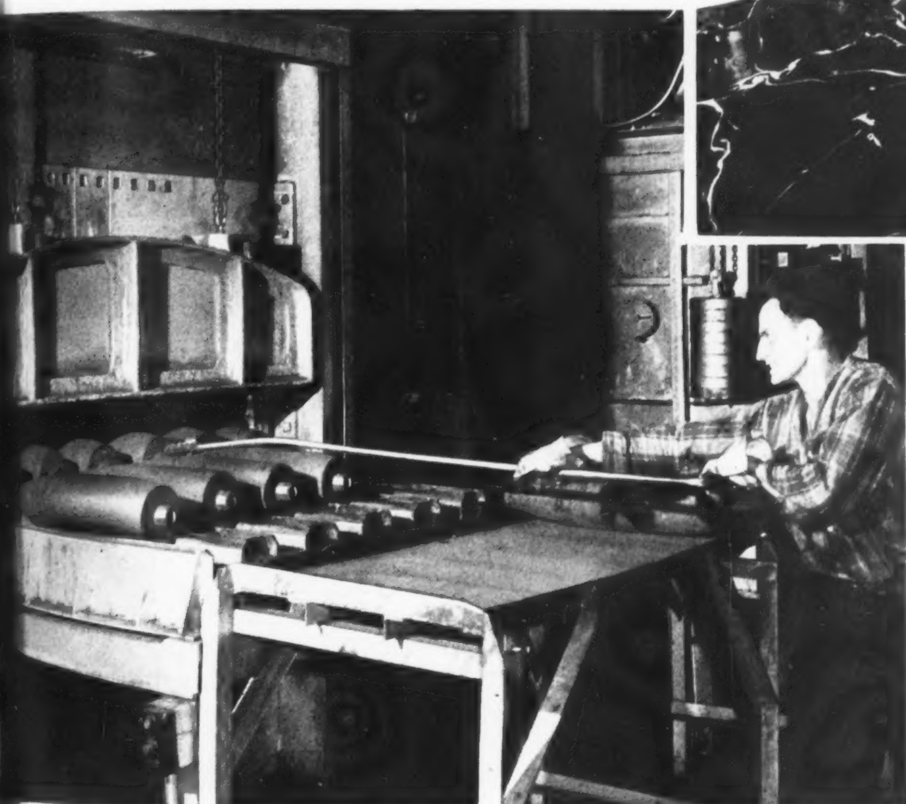


Fig. 16. From the Quench Tank into which the Shells are Automatically Discharged from the First Furnace They are Carried by Conveyor to the Tempering Furnace

Fig. 17. Shells being Ejected from the End of the Tempering Furnace after the Completion of a Heat-treating Process that Requires, in all, More than Four Hours

For the nosing operation, the heated shell is placed in a pot type die with the base end downward. Then the overhead die is brought down, and with a single pass, squeezes the nose to the desired shape. Forming is actually done by a water-cooled insert in the top die. The bottom die is also water-cooled to prevent excessive expansion. This die is mounted on a slide, which is moved forward hydraulically on the base of the press, clear of the top die, for unloading, and returned hydraulically into line with the center of the press for the next operation.

The nosed shells are then laid on the carriers of an overhead conveyor, as seen in the foreground of Fig. 14, which transfers them to the heat-treating department. There the shells are loaded six abreast, as shown in Fig. 15, on the walking beam of a long Surface Combustion gas-fired furnace. They are carried through the furnace automatically by the reciprocation of the walking beam. The length of time and the furnace temperature are regulated according to the exact carbon content of the different heats

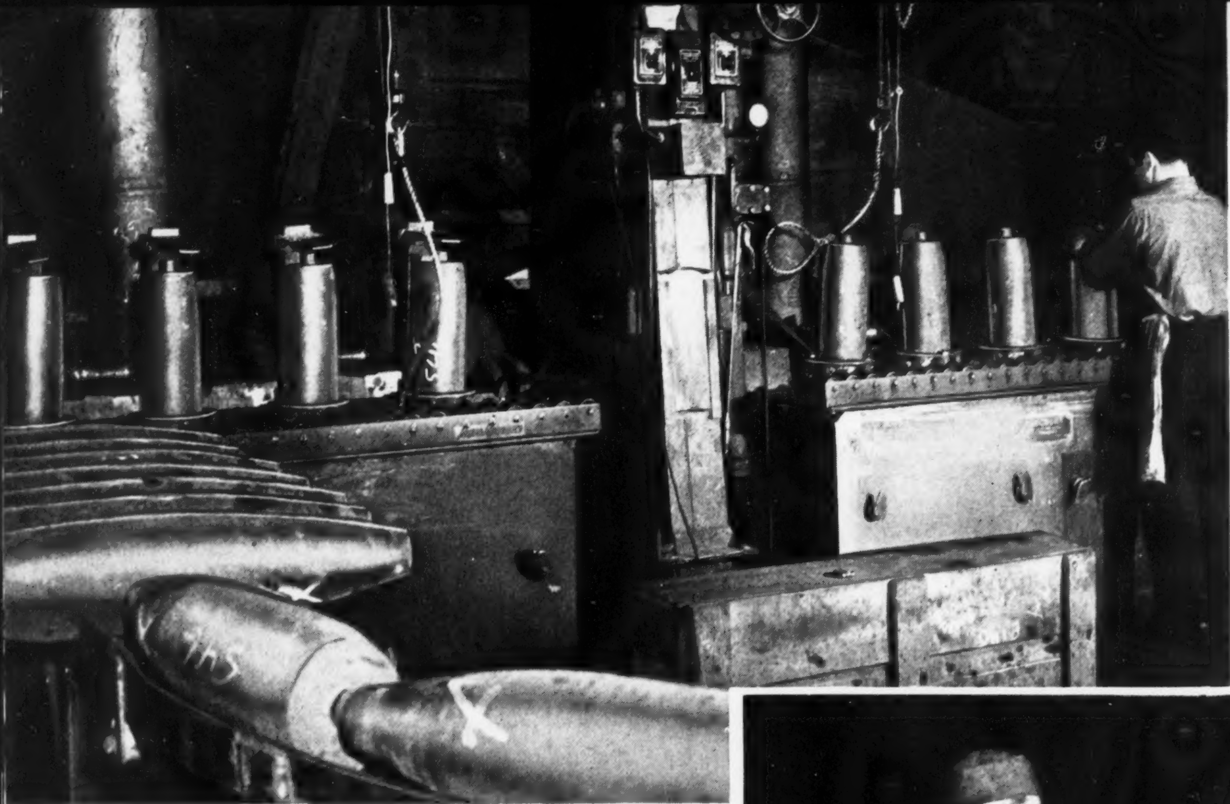


Fig. 18. After Heat-treatment, the Cavity of the Shells is Subjected to a Second Cleaning in Shot-blasting Equipment

Fig. 19. Drilling, Boring, Reaming, and Facing the Nose End of a Shell by Employing Tools on the Turret and Cross-slide of a Turret Lathe

of steel from which the shells were made. The average temperature reached by the shells before quenching is, however, approximately 1540 degrees F.

The shells are automatically quenched in oil at the end of this furnace without being exposed to the atmosphere, and are carried by a conveyor from the quenching tank into a tempering furnace in the manner illustrated in Fig. 16. The oil quenching tank is seen in the foreground of this illustration. The entire heat-treating process requires approximately 4 hours and 15 minutes. An effort is made to so control the heat-treatment as to obtain good machinability consistent with the physical characteristics specified by the War Department. Fig. 17 shows tempered shells being discharged from a tempering furnace.

Conveyors take the tempered shells to the basement of the building, where they are checked 100 per cent for hardness. Shells that give high and low Brinell readings are subjected to physical tests. All remaining shells are carried back to another shot-blasting department for a second cleaning of the inside and rust preventive dip. For the shot-blasting, the shells are placed in Pangborn machines of the design shown in Fig. 18. Here the shells are loaded in revolving sleeves with the open end downward, and steel shot is projected upward through the cavity. Four shells are handled simultaneously on each

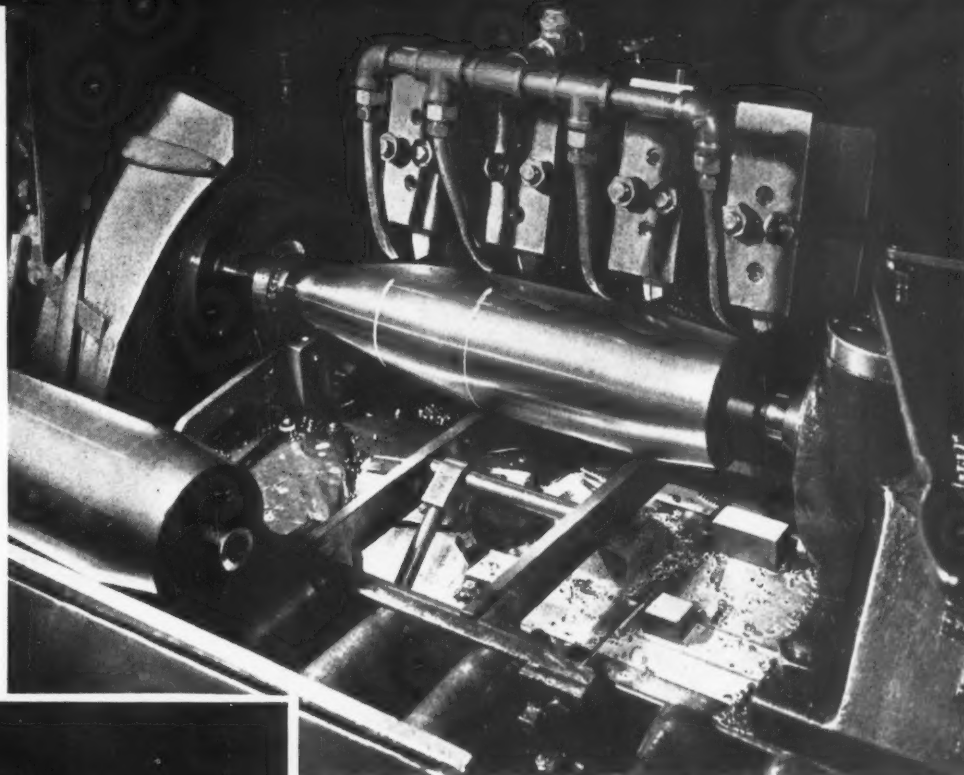


Fig. 20. Finish-turning a 155-millimeter Shell to the Proper Contour by the Use of Cam-controlled Tools

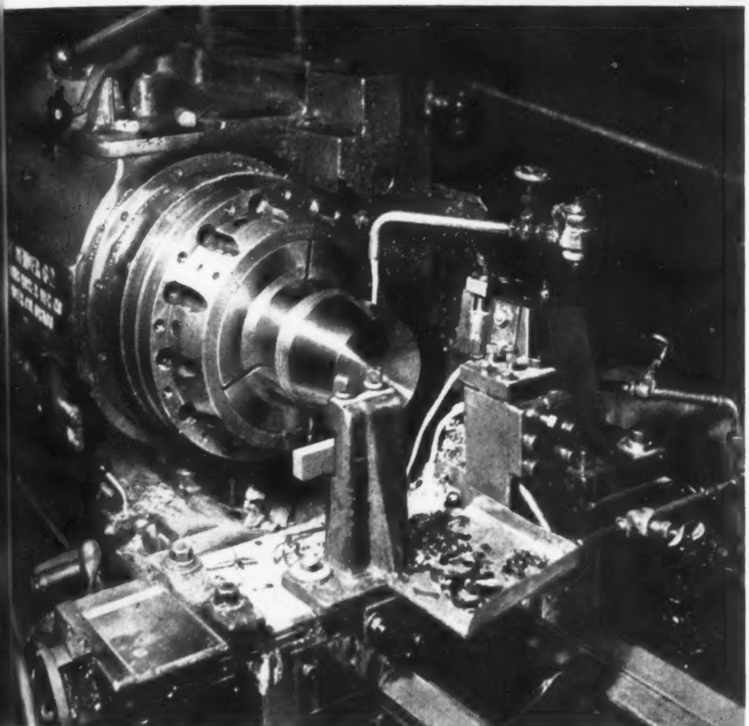


Fig. 21. The Base End of the Shells is Faced off to Give the Proper Shell Weight and, at the Same Time, a Groove is Cut to Receive the Copper Rotating Band

side of the machine. There are tilting devices at the back which are swung upward to receive the shells and are then dropped back to facilitate unloading.

At the end of the operation, the shells roll to a gravity conveyor at the rear, where an inspector equipped with an electric light bulb on a rod checks the appearance of the shell cavity. The shells are next carried by the roller conveyor to a tank containing a Quaker Chemical rust-preventive solution, into which the shells are automatically dipped.

An overhead conveyor then carries the shells back to the machine shop, where the nose end is machined in Denver turret lathes (built by the Stearns Roger Mfg. Co., Denver, Colo.), which are tooled up as shown in Fig. 19. The first step in the operation consists of feeding a drill on one of the turret stations into the nose end to open up the hole. Then a second drill, with the cutting edges ground back, is advanced for facing the shell end. Next, a bar with two cutters, one for boring the hole and the other for semi finish-facing the nose end, is brought forward. Then a reamer on the turret is advanced for finishing the hole. Finally, a tool on the back of the cross-slide is used for finish-facing the shell nose. The base end of the shell is firmly seated in a large collet chuck that is opened and closed by air pressure.

Finish-turning of the shells takes place next, either in Hepburn or Stamets automatic lathes. A typical operation on a Stamets lathe is illustrated in Fig. 20. It will be seen that the tooling is similar to that on the semi finish-turning lathe shown in Fig. 11. The tools are automatically moved up and down by a stationary cam-bar as they are fed from right to left for turning the boat-tail, body, bourrelet, and ogive to the specified dimensions and contour. The bourrelet dimension is held closest, the total tolerance being only 0.005 inch. The tolerance on the body is plus or minus 0.010 inch. Hepburn lathes used for this operation are equipped with two tools only. As in roughing and semi-finishing, carbide-tipped tools are employed.

In some instances, difficulty is experienced in holding the bourrelet to the required size for a number of reasons. On machines where this difficulty arises, the practice is to hold the bourrelet to the high limit, and if it is turned over size, the shells are passed to a machine that is set up for turning the bourrelet only.

Each shell is next weighed on a Toledo scale to determine how much stock should be removed from the base end in order to bring the shell to the specified weight. A piece of paper with the overweight marked on it in tenths of a pound is attached to the shells to indicate how much stock should be removed by the operators of the Denver lathes to whom the shells are next passed. These machines are fitted with a facing tool on the front of the cross-slide, as shown in Fig. 21, which cuts off the boss on the base end of the shell. Then a wide facing tool mounted farther back on the cross-slide is advanced for finish-facing the base end in accordance with the specifications on the paper, and finally a forming tool at the back of the cross-slide is brought forward for cutting a groove in the body to receive a copper rotating band. Several annular rings are left in the bottom of the groove by the form cutter, which is made of high-speed steel. The groove is turned to a "Go" and "Not Go" snap gage.

Fig. 22. (Above) Knurling the Annular Ridges in the Groove to Insure Firm Seating of the Rotating Band

Fig. 23. (Left) Assembling the Copper Rotating Band in a Press Provided with Six Horizontal Pneumatically Operated Jaws

The shells are next passed to a Morley knurling machine, such as shown in Fig. 22. Each shell is placed vertically on a revolving plate between two rollers at the back of the machine and a revolving knurl at the front. Knurling marks are pressed into the annular rings left at the bottom of the groove as the shell rotates. The rollers at the back of the machine are forced firmly against the shell by air pressure, pushing it against the knurling tool.

After a small staking notch has been cut in the nose in a simple operation on a horizontal milling machine, the shells reach Tire Setter machines of the type illustrated in Fig. 23, where bands of pure copper or gilding metal are firmly squeezed into the groove under the action of six pneumatically operated jaws. The total pressure exerted by these jaws is between 1200 and 1400 pounds. Pressure is applied several times, and the shell is indexed between each application to insure tightly fitted bands.

The shells go next to Denver automatic lathes, set up as illustrated in Fig. 25. A form tool at the back of the cross-slide turns the band and cuts a groove in it; a double-point cutter on the cross-slide is applied underneath the shell to face both shoulders of the copper band to the required width; and a roller at the front of the cross-slide marks the band with the necessary identification. Correct setting of the shell in the chuck is insured by the use of a dial gage on the cross-slide for checking the distance from the base end of the shell to the chuck face.

All shells must now pass inspection by Pratt & Whitney Electrolimit gages of the type shown

in Fig. 24, which check six dimensions on the bourrelet band and body. Above the gaging elements there is a panel equipped with six green lights on the left-hand side and six red lights on the right-hand side. The shell is placed vertically on a slide and pushed between contacting fingers on the gaging elements. All red lights go out as soon as a shell is placed on the slide and remain extinguished when the shell is pushed between the gaging elements unless it is

Fig. 24. (Above) Getting Ready to Check Six Diameters on a Shell by Means of an Electrolimit Gage

Fig. 25. (Right) Operation in which the Copper Band is Form-turned and Grooved, Faced on the Shoulders, and then Marked

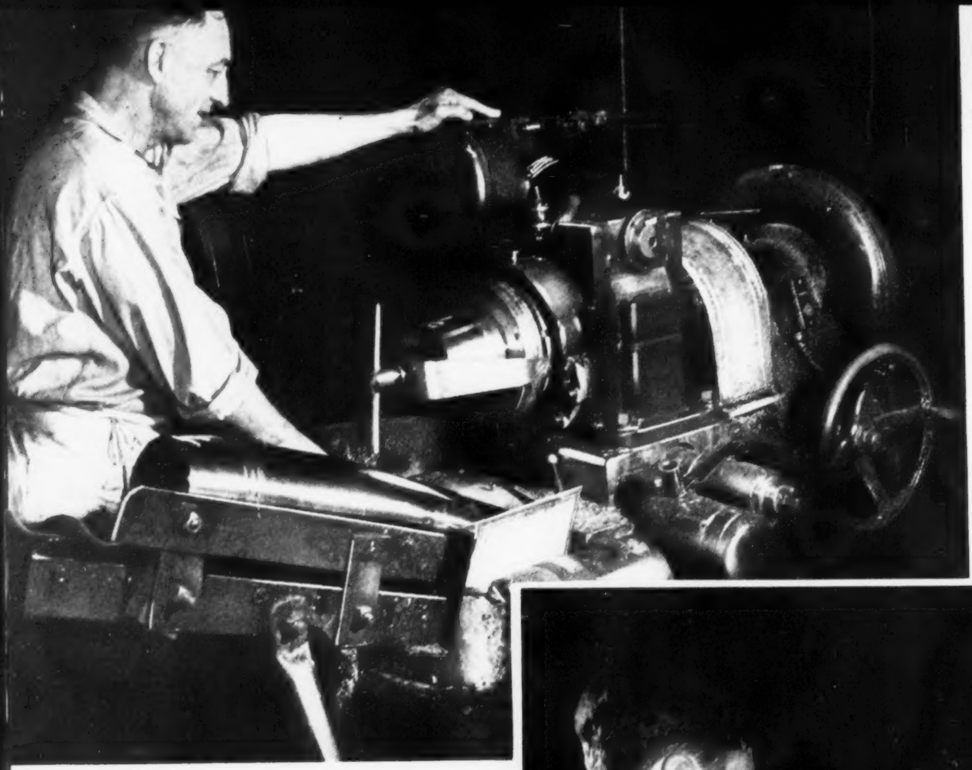


Fig. 26. Cutting an Internal Thread in a Shell Nose to Receive the Booster by Employing a Thread Milling Machine

Fig. 27. Thin Steel Disks are Spot-welded Carefully on the Base End of the Shells to Provide a Seal against Invisible Cracks that might Cause Premature Explosion of the Shells

over size at any point. In such a case, the red light corresponding to the element that registers the over-size condition will turn on automatically.

Conversely, all green lights will remain on until the shell is pushed between the gaging elements, at which time all of these lights will go out unless a dimension is under size at any point. Shells that fail to pass this inspection are sent to a "hospital line" for correction, while shells that meet all requirements are turned over to government inspectors.

Upon the completion of government inspection, the shells are passed to Lees-Bradner machines of the design shown in Fig. 26 for milling a thread, 2 inches in diameter by about 1 1/4 inches long, in the nose to receive a booster that is screwed in at the loading plant. The thread is cut by conventional thread milling practice through the use of a multiple thread cutter.

The shells are next carried on the gravity conveyor to large Blakeslee washing machines of the type shown in Fig. 28, where they are transferred to chain link conveyors, on which they are suspended vertically, with the nose end downward, for passage through the washers. Solventol is thoroughly sprayed into the shell cavities and on all external surfaces with this equipment in order to remove all dirt and grease. Upon being discharged from these machines, the shells are inspected visually, and any marks are wiped off with a cloth.

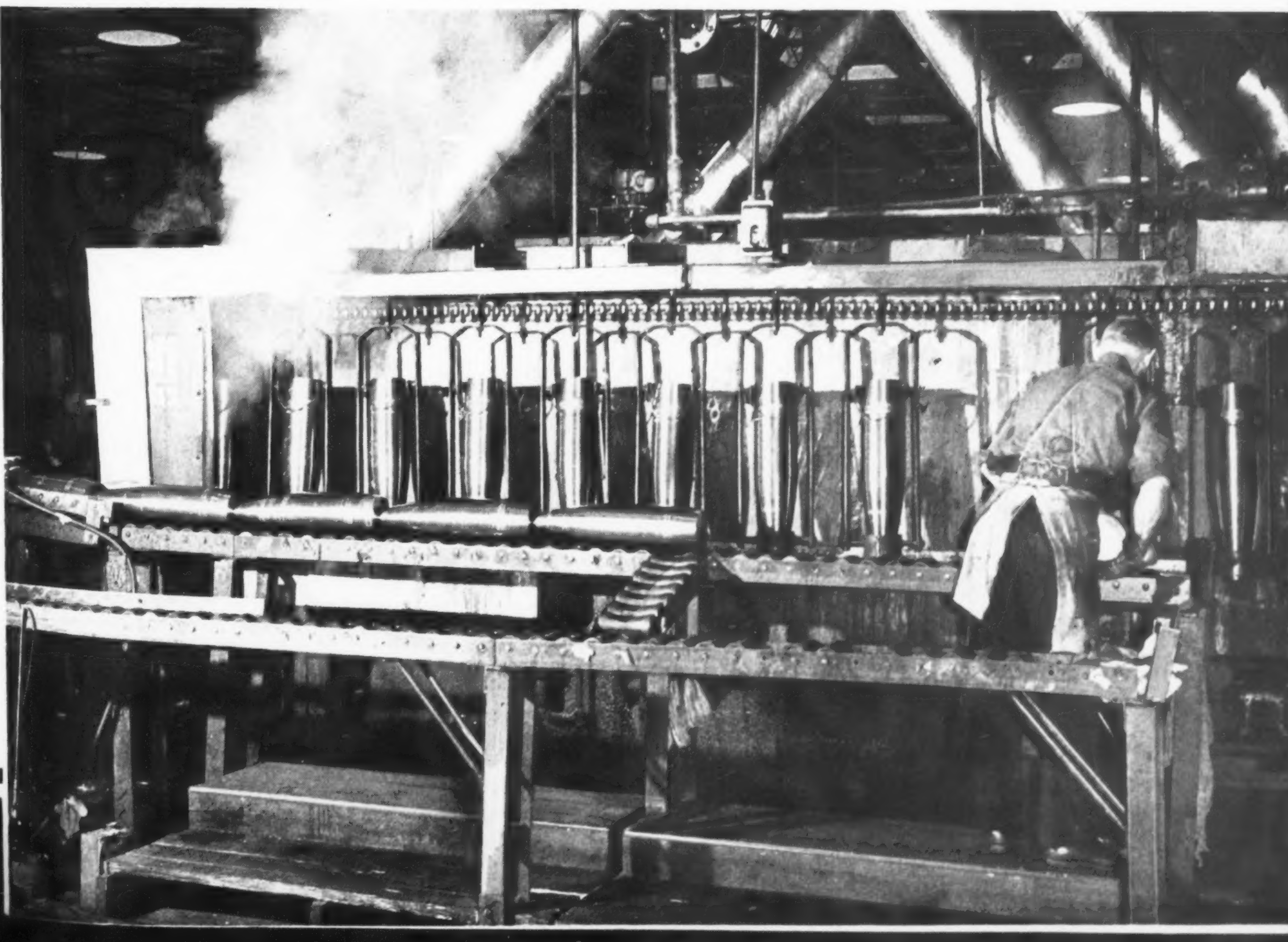
Roller conveyors then carry the shells to Toledo scales having portions of conveyor track attached to the scale platforms. Government inspectors here make certain that the shells are of the prescribed weight within plus or minus 0.10 pound. From this point, the shells go to Thomson-Gibb spot-welding machines designed, as shown in Fig. 27, with two roller electrodes. Here the shells are placed in revolving fixtures with the base ends uppermost, and a thin disk of steel is attached to the base ends by overlapping spot welds around the disk, which securely fasten it to the shell without any air vents. The steel disk serves as a seal for any invisible cracks that may exist in the shell base and that might admit gas generated by the propelling charge into the inside of the shell when it is fired from a gun.

The two fixtures are mounted on a slide and are alternately shifted into the working position by means of an air cylinder. This arrangement permits one fixture to be loaded while a shell in the other fixture is being welded, and thus enables welding to be performed practically continuously. This arrangement has enabled each machine to do the work of two machines formerly provided with only one work fixture.

Upon completion of the welding operation, each shell is given an acceptance stamp by an Army Ordnance representative. Masking tape is then applied around the rotating band, after which the shells are painted black on the inside by a spray gun fitted with a long nozzle, so that the bottom of the cavities can be easily reached. The outside of the shells is then completely lacquered, except for the rotating bands, as the shells are carried past paint spray booths by an overhead conveyor. The lacquer dries quickly, as the shells are still hot from the washing operation, and the masking tape can, therefore, be taken off at once by men seated at the right of the spray booths.

When the shells are taken from the paint conveyor, they are placed upright on trucks, and rope grommets are slipped around the bodies just above the rotating band to prevent the shells from coming in contact with each other and becoming damaged during shipment. They are transported by the trucks to box cars for delivery to explosive loading plants.

Fig. 28. The Shells are Thoroughly Cleaned on Inside and Outside by Conveying Them Nose Downward through a Washing Machine



Bombs FOR BLASTING BERLIN

The Manufacturing Technique Developed for the Mass Production of 1000-Pound Demolition Bombs

By VINCENT R. WHITENIGHT, Assistant to District Manager
American Car and Foundry Company, Berwick, Pa.

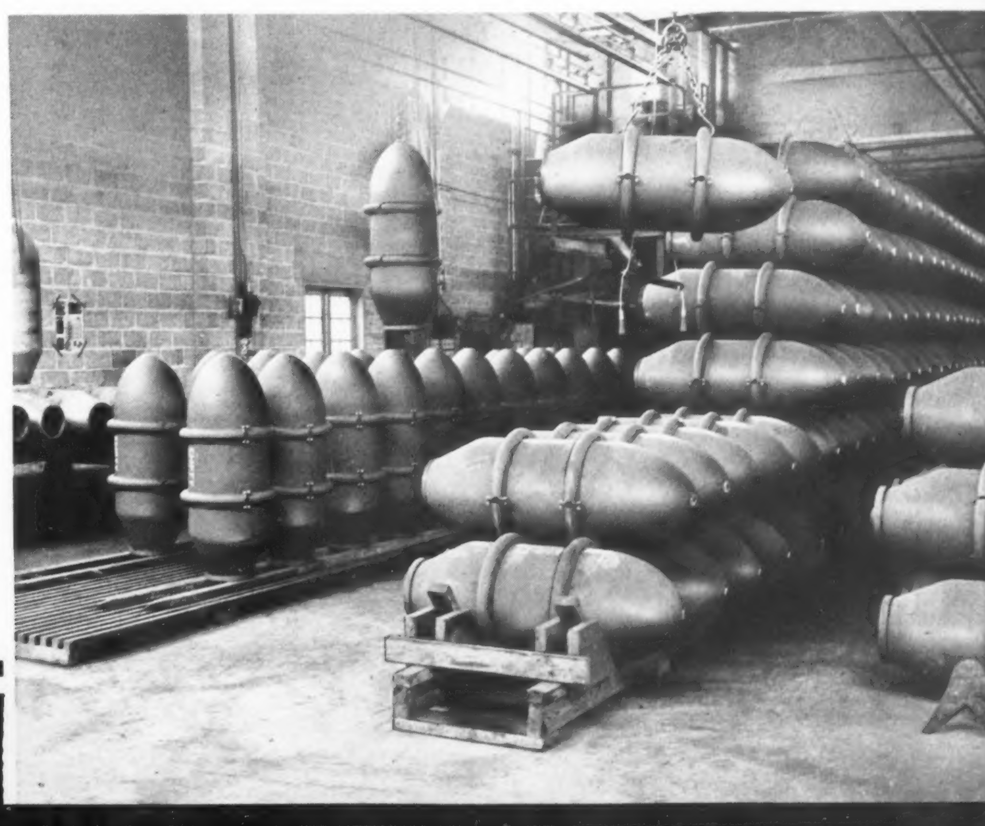
ONE of the most important ordnance problems at the beginning of this war, which was non-existent in World War I, was the production of thousands upon thousands of bombs for blasting the army, naval, and manufacturing centers of our enemies. As in the case of other munition manufacturing problems, this one was solved by the development of manufacturing techniques that insure high quality products in sufficiently large quantities to meet the needs of our Air Forces and those of our Allies.

Owing to the mechanical construction of bombs, industrial plants engaged in the fabrication of cylindrical products from steel plates, such as small or medium-size tanks, are best fitted for bomb manufacture. It was for this reason that the American Car and Foundry Company became interested in bomb manufacture nearly two years before our entry into the war, and obtained a contract for producing the metal parts that make up one type of 1000-pound demolition bomb. The work on the bomb shells is being done in the Berwick and Milton, Pa., plants of the company, which, during peacetime, are engaged principally in manufacturing tanks and railway cars. Manufacture of the base plugs, fuse parts, and fins has been let out to sub-contractors. The base plugs are, however, assembled to the bombs before they are shipped from the Berwick plant.

Preliminary operations are performed at the Milton plant, where flat plates of carbon steel are received from the steel mill sheared to the required dimensions. These plates measure approximately 55 by 58 inches. All plates are carefully inspected for cracks or other flaws along the edges that might cause difficulty during the manufacture of the bombs. A certain number of each lot are also checked for dimensions.

The first operation on these plates consists of planing a 1/8-inch bevel along the lengthwise edges on both sides of the plates, and also planing the edges at an angle of 5 degrees from the bevel that will be on the outside of the rolled bomb to the inside bevel, as illustrated in the upper diagram of Fig. 5. Then when the plate is rolled into a cylindrical shape, there will be a V-groove running the length of the bomb on both the inside and the outside, as indicated in the lower diagram. These grooves are for the purpose of receiving weld metal in Unionmelt welding operations. The beveling operation is performed on the planer shown in Fig. 3, which is provided with a structural jig that facilitates clamping the plates and insures proper align-

Fig. 1. Bombs with Protecting Rings Attached, Ready for Shipment to Explosive Loading Plants



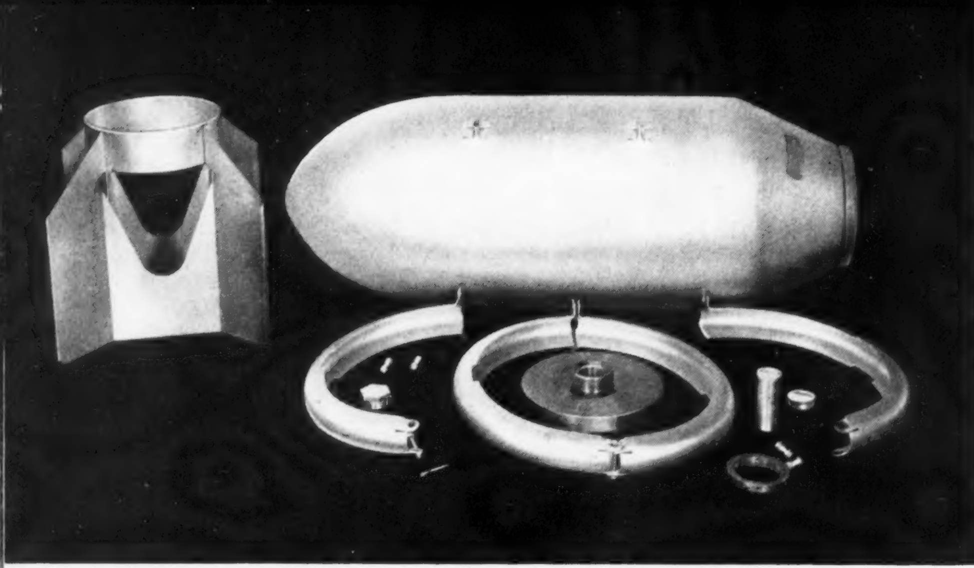


Fig. 2. A 1000-pound Bomb, with Base Plug, Fuse Parts, Fin, and Protecting Rings

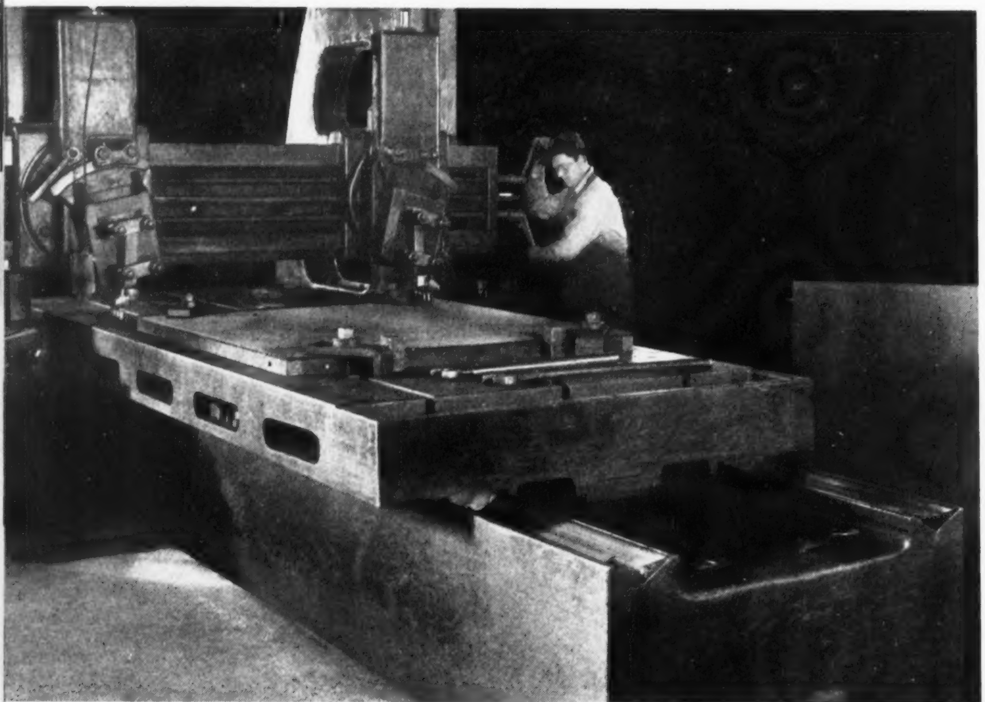


Fig. 3. Planing Beveled Edges on the Opposite Sides of Flat Steel Plates that are to be Formed into Bombs

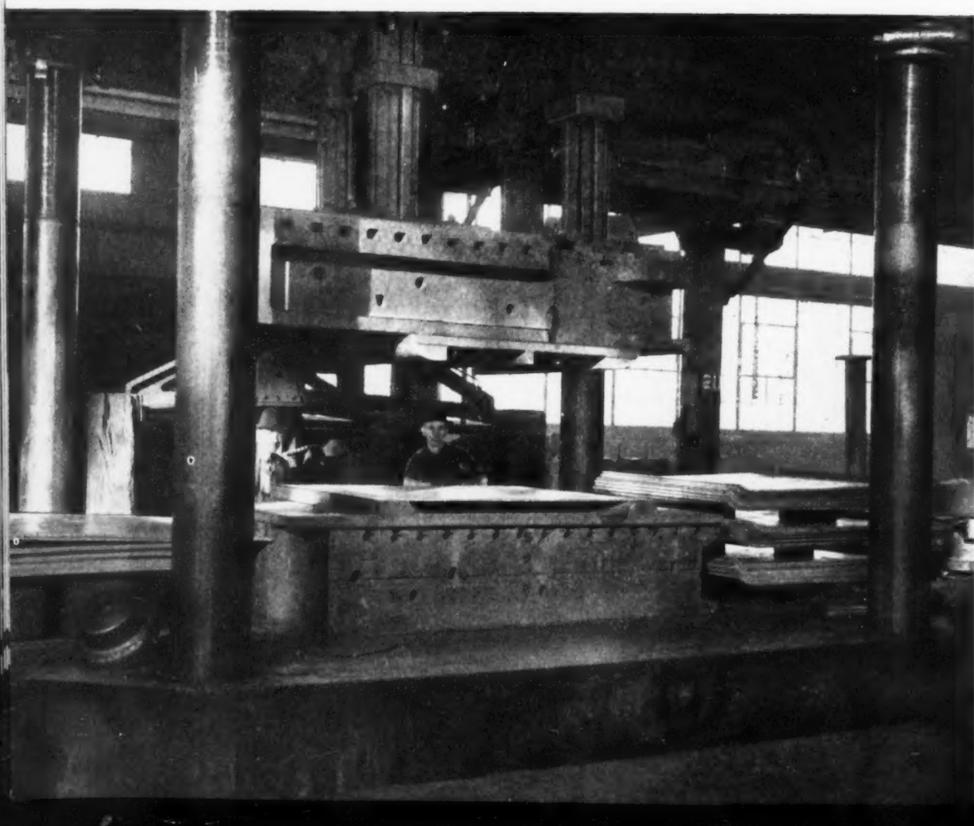


Fig. 4. The Plates are Crimped along Two Edges in This Heavy-duty Hydraulic Press to Facilitate Rolling into Cylindrical Form

ment relative to the two cross-rail tool-heads. The plates are planed on two sides at the same time.

The next operation consists of crimping or bending up the two lengthwise edges of the plates to a radius of about 5 inches, so as to prepare the plates for rolling into cylinders. The crimping is done on the Baldwin Southwark 1100-ton hydraulic press illustrated in Fig. 4, which is constructed with a vertically moving bottom platen and table. The steel plate is laid on a die fastened to the table in the manner shown. Then hydraulic pressure is admitted into cylinders beneath the floor, and the platen and table ascend and press the plate against another die member attached to the upper stationary platen. When the table again moves down, the plate has been bent to the shape of those seen piled up at the right of the machine.

The crimped plates are next wire-brushed along the planed edges to remove all grease, dirt, or rust that would prevent satisfactory welding later on. This is done by means of portable electric brushes, after which the plates are transferred to the Bertsch rolling machine, illustrated in Fig. 6, and rolled into cylinders. The two bottom rolls of this machine are adjustable in relation to the top roll, so as to enable parts to be rolled to various diameters.

The rolls are provided with a quick reversing motor, so that the direction of rotation can be alternated and the plate rolled back and forth until the desired shape has been attained. An effort is made to obtain as complete a cylinder as possible in the first pass of the plate between the rolls, because the material work-hardens in this operation. When the operation is finished, the housing at the left-hand end of the machine is swung outward by hydraulic action, and the left end of the upper roll is elevated slightly, so as to permit slipping the rolled cylinder out from between the rolls.

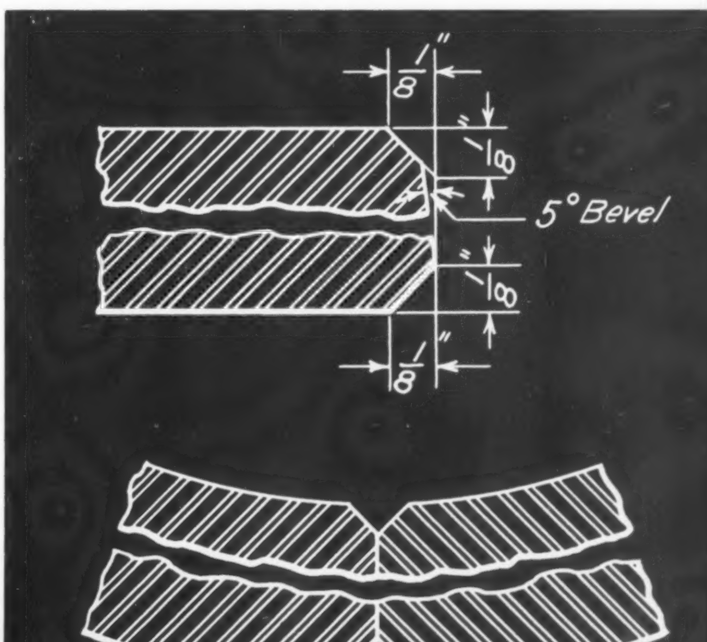
From the rolling machine, the partially formed bombs are transferred by a jib crane to a gravity conveyor, down which they roll to the fixture shown in Fig. 7. With the bomb mounted on four small rollers on the table, four steel cables, each of which is attached at the back of the fixture to the linkage of an air cylinder, are passed under and up the front of the bomb. Then the front end of each cable is attached to the linkage of the same air cylinder. When pressure is admitted into these air cylinders and the piston-rods come down, the links are straightened out and the cables are drawn taut, pulling the two edges of the bomb tightly together. Blocks at the lower ends of the piston-rods hold the lengthwise edges of the bomb in line with each other.

With the bomb cylinder thus firmly held, welders attach a tab of steel plate, about 3 inches wide by 4 inches long, at each end of the split to hold the bomb edges tightly together, and also tack-weld at two points along the split. The tabs also serve the purpose of aiding in the Unionmelt welding operation that follows. The tabs are welded on both the top and bottom.

The tack-welded bomb cylinders next roll on the wooden gravity conveyor to the Unionmelt welding machine shown in Fig. 8, for welding the seam. The inside is welded first, with the bomb clamped on top of a trough that is filled with welding flux. Again, steel cables tightened by air cylinders are employed to hold the work in place after it has been carefully aligned with the path of the welding head. This is accomplished through lateral adjustments provided on the floor fixture on which the flux trough is supported. The welding head is mounted on the end of a long ram, attached to a carriage that is automatically fed along the ways of the bed seen at the left. The ram is long enough to enable the welding head and flux hopper to be fed completely through the bomb.

In an operation, air is first admitted into a hose that extends the full length of the trough and is embedded in the flux. When the hose is inflated, it forces the flux tightly against the

Fig. 5. Diagram Showing how the Flat Steel Plates are Beveled before being Rolled into Cylinders



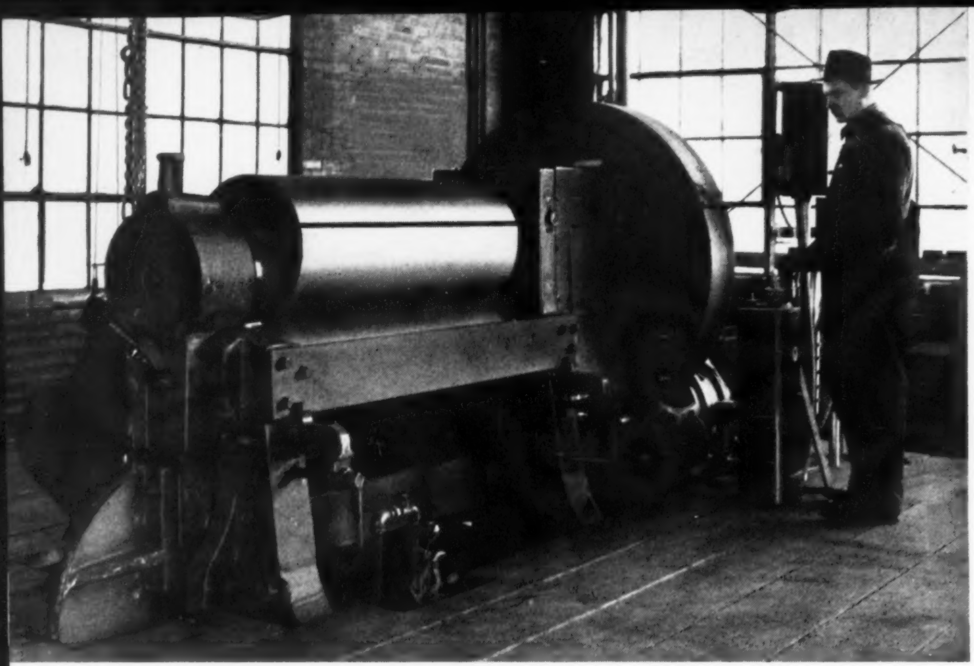


Fig. 6. Rolling a Steel Plate that has been Crimped into a Cylinder; the Housing at the Left-hand End of the Machine Swings Open for Removing the Work

seam of the bomb cylinder on the under side, and thus controls the deposit of weld metal on the under side of the work. Then the welding operation is started at the right-hand end of the bomb, as seen in the illustration, the arc being started on the tab that was welded at this end, thus insuring full penetration of the weld metal for the entire length of the bomb. The bomb is welded for a length of 6 inches only at this end, after which the welding head is moved to the far end of the bomb, and weld metal is deposited for the full length of the work, up to the weld metal that was laid at the beginning of the operation.

The practice of welding for only a short distance at one end and then changing to the opposite end insures uniform heating of the bomb and guards against distortion. Welding along the inside of the seam is performed at the rate of 14 feet a minute. Electrode wire is fed automatically from a reel on the welding carriage. The man seen at the right in the illustration sucks up the flux with a vacuum hose from the inside of the bomb as the welding head moves along.

The outer side of the welded seam is then gouged out by means of pneumatic chipping hammers, so as to remove any impurities in the weld metal. The metal is cut out to a depth of about 3/16 inch. Welding is then performed along the outside of the seam by using the same equipment as was employed in welding the inside. However, in this case, there is no necessity for using a trough of flux beneath the bomb. Instead, a low table with rollers is substituted for the trough, as shown in Fig. 9, and the bomb is supported directly on the rollers. Again, the work is lined up with the path of the welding

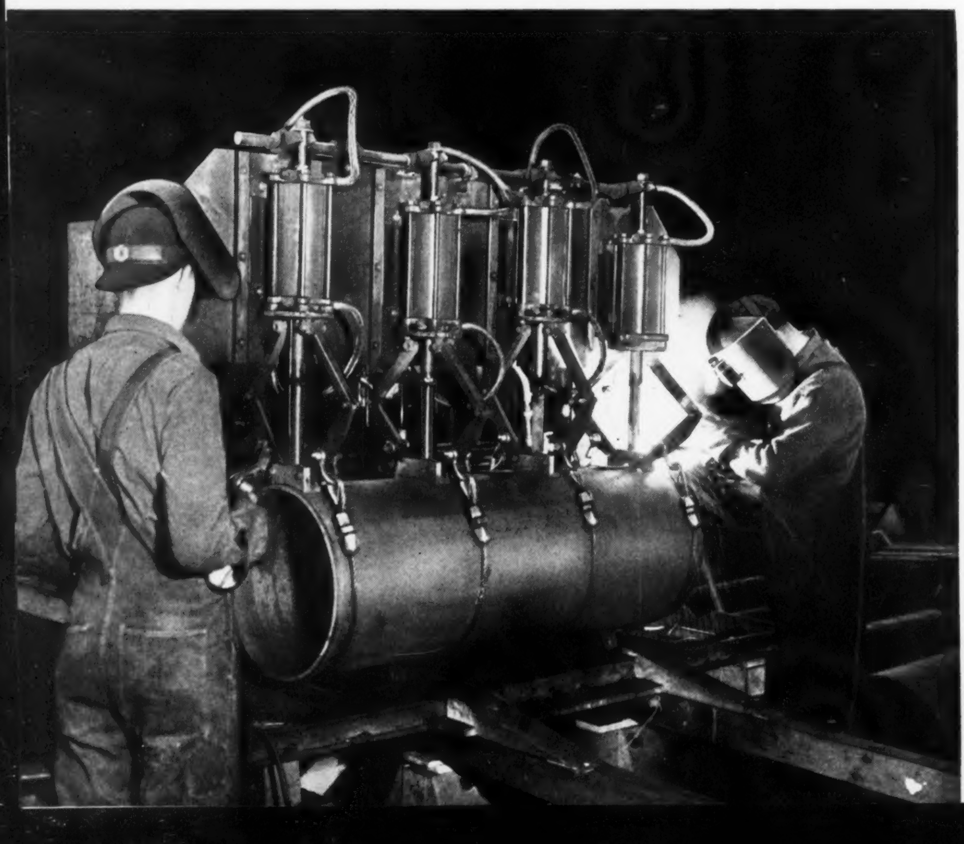
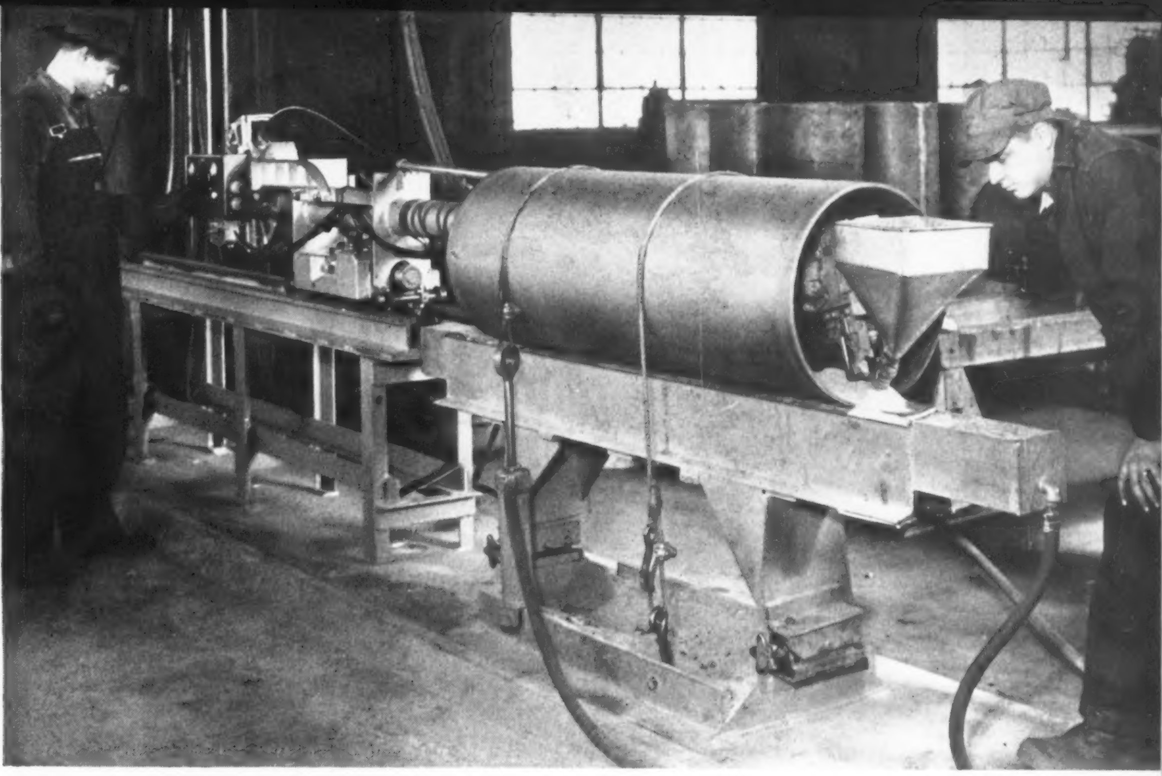


Fig. 7. Fixture with Four Air Cylinders for Holding the Edges of the Rolled Cylinder Tightly together during Tack-welding



ram by lateral adjustment of the table supports. A simple structural member is laid on top of the bomb to keep the welding flux from sliding off the bomb on the floor. This device is slipped over the tabs at the opposite ends of the bomb to hold it in place.

In welding the outside of the bombs, the speed is 16 inches per minute, and less amperage and voltage are used than in welding the inside of the seam. A jib crane is also provided at this machine to facilitate moving the bombs to and from the gravity conveyors. The practice is, of course, to weld a quantity of bombs on the inside before setting up the machine for performing the welding operation on the outside.

The tabs are next cut off the ends of the bombs, and then the welds are cleaned up wherever necessary by applying pneumatic chipping hammers, as shown in Fig. 10. Next, the weld metal is ground flat on the outside for a distance of 24 inches on the end that will be formed into the nose by employing a portable pneumatic grinder, as illustrated in Fig. 11, after which it is ground on the inside at the same end for a distance of 15 inches. Similarly, the weld metal is ground flat on the tail end for a distance of 16 inches on the outside and a distance of 5 inches on the inside. Experience has shown that unless the bombs are ground inside, as well as outside, they will become distorted.

Fig. 8. (Above) The Bomb is Welded along the Inside by the Unionmelt Process while Clamped Tightly on a Box of Welding Flux

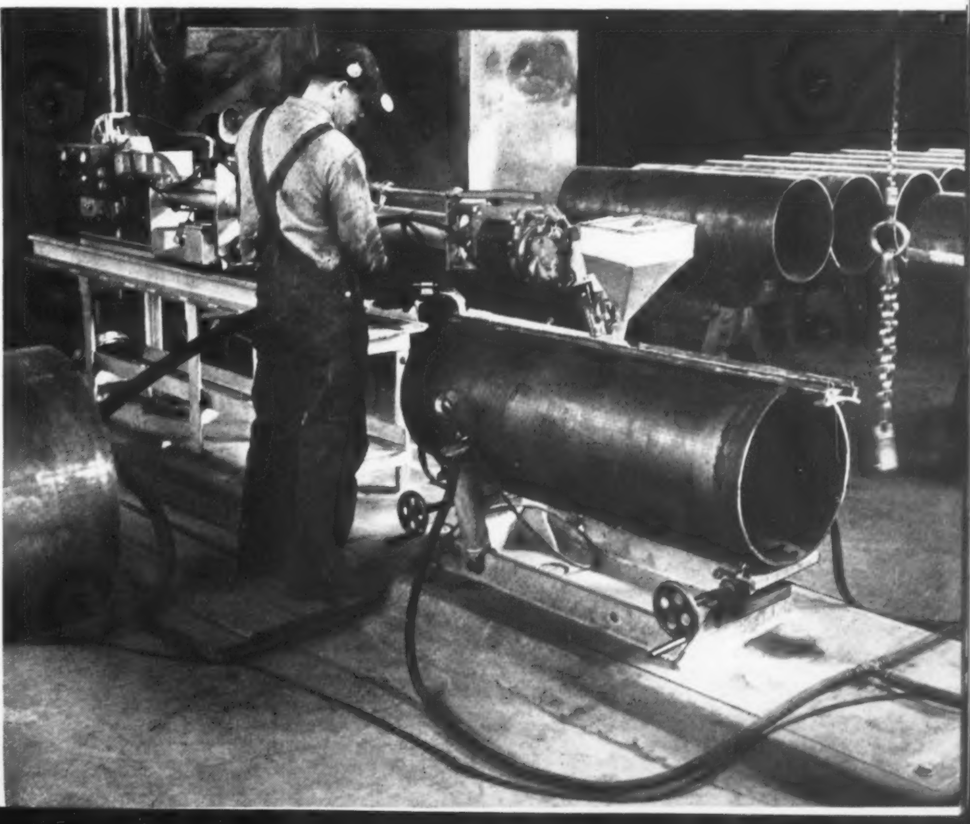


Fig. 9. (Right) The Outer Seam of the Bomb is Welded with the Same Equipment Used in Welding the Inside, but a Different Method of Supporting the Work is Employed

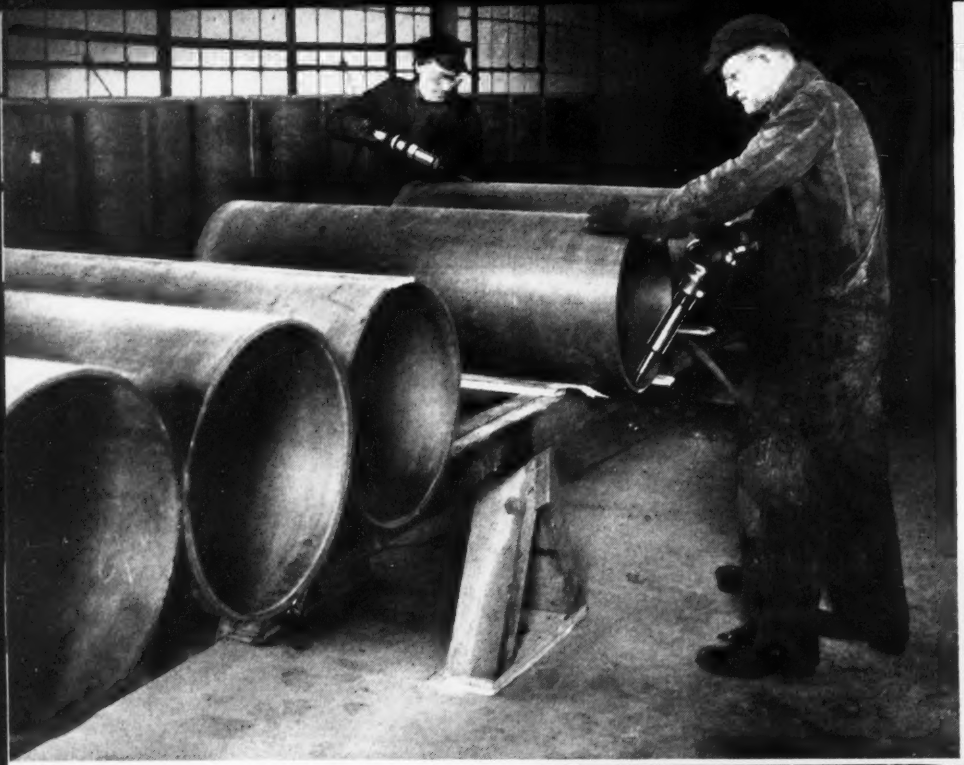


Fig. 10. (Left) The Weld Metal is Chipped Flat on Both the Inside and Outside of the Bombs and at Both Ends

Fig. 11. (Right) Grinding the Weld Metal Flat after the Chipping Operation Seen in Fig. 10

Following this grinding operation, the bombs are taken to the bulldozer shown in Fig. 12, and pressure is applied a number of times between indexings of the bombs, so as to make them as cylindrical as possible. When the bombs leave this machine, they must not be more than 1/8 inch out of round. The position of the stationary anvil on the bulldozer and the stroke of the ram are so adjusted as to insure a certain amount of spring-back of the bomb each time that the ram moves away from the work.

Each bomb is now carefully examined for visible defects, and every tenth bomb is X-rayed for the full length of the seam, so as to detect any flaws in the interior of the weld metal. The X-ray negatives are 17 inches long, and four negatives are exposed on each bomb. Bombs have been produced in lots as great as four thousand without a single rejection for faulty welding. The X-rays are taken with the General Electric equipment shown in Fig. 13, the negatives being firmly held against the inside of the bombs as indicated. In the background of the illustration, is seen a large tank that is typical of the principal products of this plant.

The bombs are next shipped to the Berwick plant, where the first operation consists of forging the tail end. The bombs are heated to forging temperature by inserting the tail end into openings in furnaces such as seen in Fig. 14, although this illustration actually shows bombs in the furnaces after they have already been forged on the tail end and are being reheated preparatory to forging the nose. During the

heating of the bomb ends in these furnaces, a water spray is directed around each bomb in front of the furnace opening so as to localize the heating.

When the bombs have been brought to forging temperature, they are transferred by an overhead crane to the Chambersburg 2000-pound steam hammer and A.C.F. rotating machine seen in the background of the illustration. Here the bomb is first laid on a small air-operated table, which raises it into line with the center of the rotating machine. Then the nose end of the bomb, which has not yet been formed, is gripped in the jaws of an air-actuated chuck on a hydraulically operated slide of the rotating machine. The table on which the bomb has been supported is then depressed, after which the slide of the rotating machine is fed forward to bring the tail end of the bomb into position in the bottom half of the forging dies seen in Fig. 15.

Between successive strokes of the hammer the bomb is advanced short distances into the die, and forged until the final shape of the tail end has been obtained. When the bomb has been fed into the die the required amount, an indicator mounted on the stationary bed of the rotating machine will coincide with the central graduation on a scribed plate attached to the sliding head of this machine. This device enables the

Fig. 12. (Left) A Bulldozer Exerts Pressure on the Wall of the Bomb after Successive Indexings to Insure Roundness within 1/8 Inch

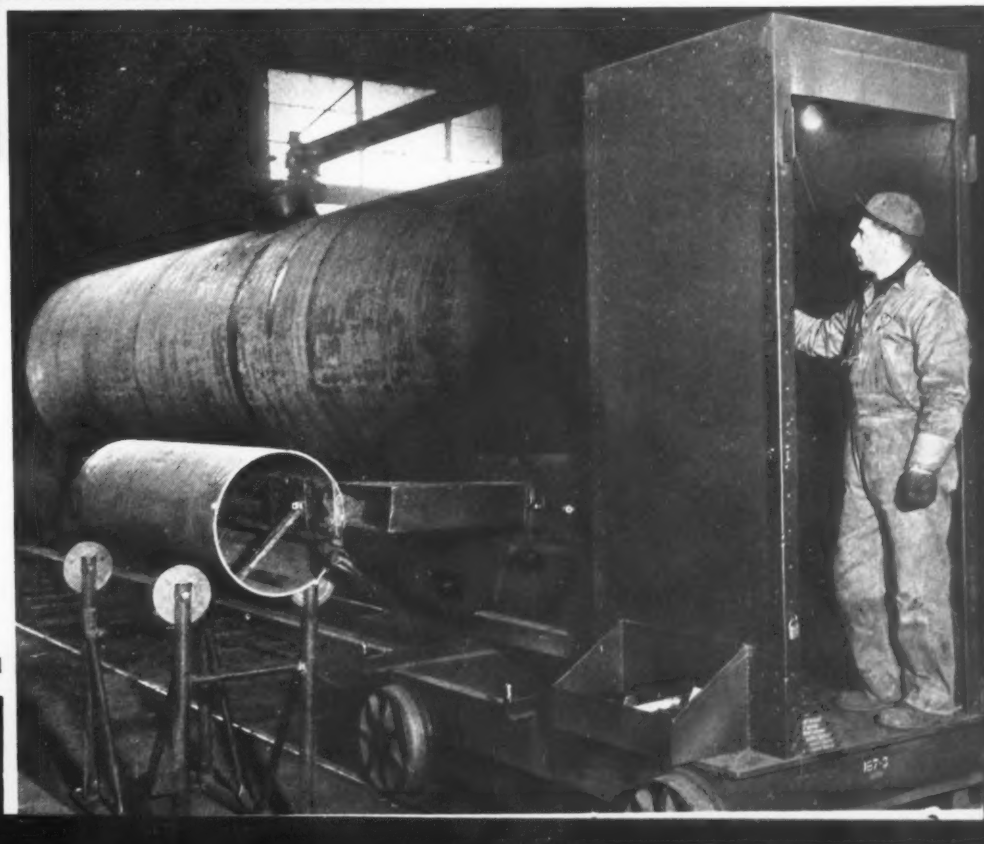
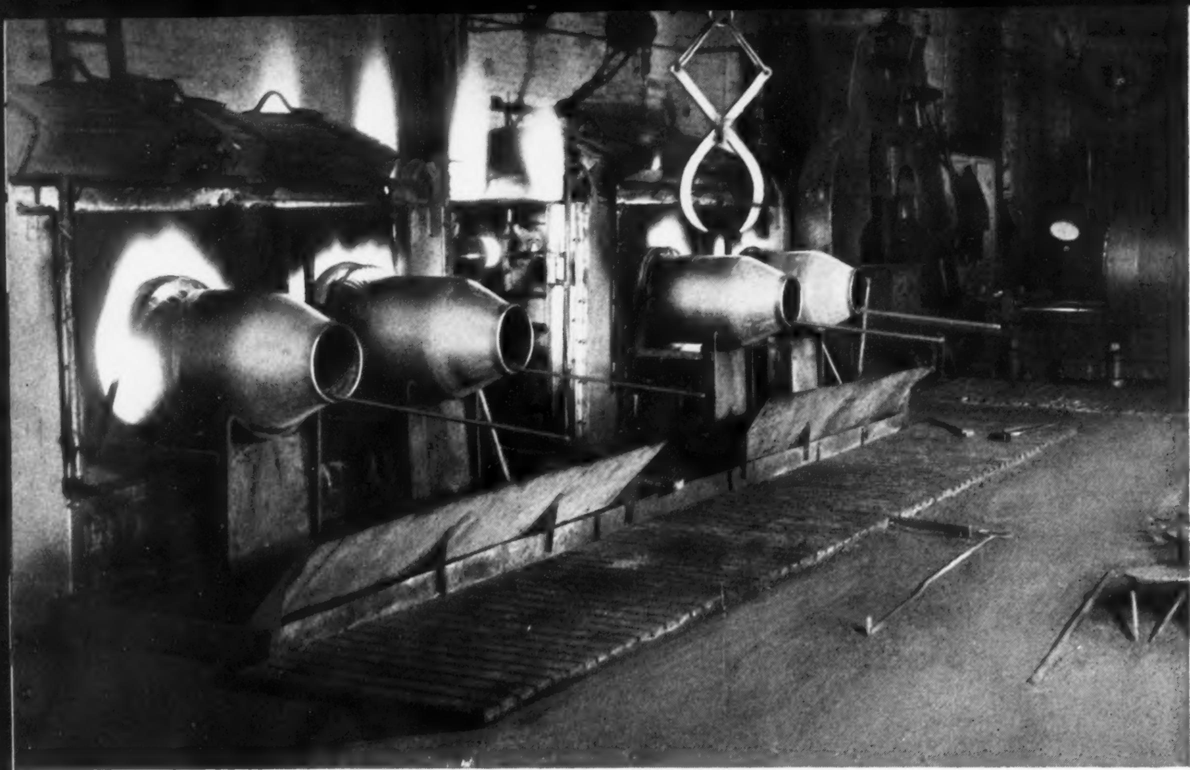


Fig. 13. (Right) X-ray Pictures are Taken the Full Length of the Welded Seam on Every Tenth Bomb to Guard against Defective Work



operator to control the progress of the operation accurately. The end of the operation had just been reached when the photograph shown in Fig. 15 was taken. The tail is formed in one operation under the hammer, this end of the bomb being closed to a diameter of about 9 3/4 inches.

After a large number of bombs have been forged on the tail end, the dies in the forging machine are changed for nosing dies. The bombs are then heated in the furnaces on the nose end, as shown in Fig. 14, after which they are forged as illustrated in Fig. 16. The process of forging the nose is the same as forging the tail end, except that three separate forging operations are necessary and the bombs must be reheated between each one.

In the first operation, the nose is brought practically to the required shape, the bomb being closed until the hole in the end is only about 2 1/2 inches in diameter. In forging to this shape, the thickness of the metal in the nose end is increased. This is the most important of the three operations, because if the bomb is not forged properly at the beginning, the wall at the nose end is likely to collapse. In the second nosing operation, the hole is closed to a diameter of 1 inch, and the thickness of the metal in the nose is further increased. In the third operation, the nose is brought accurately to size. It

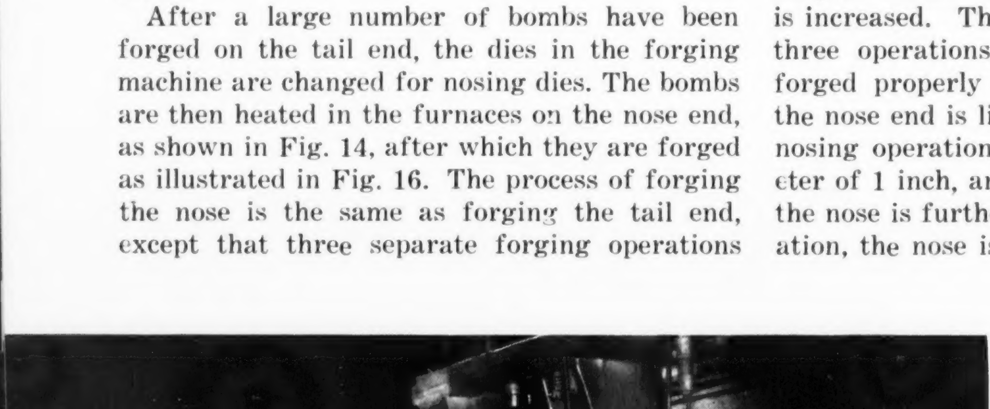
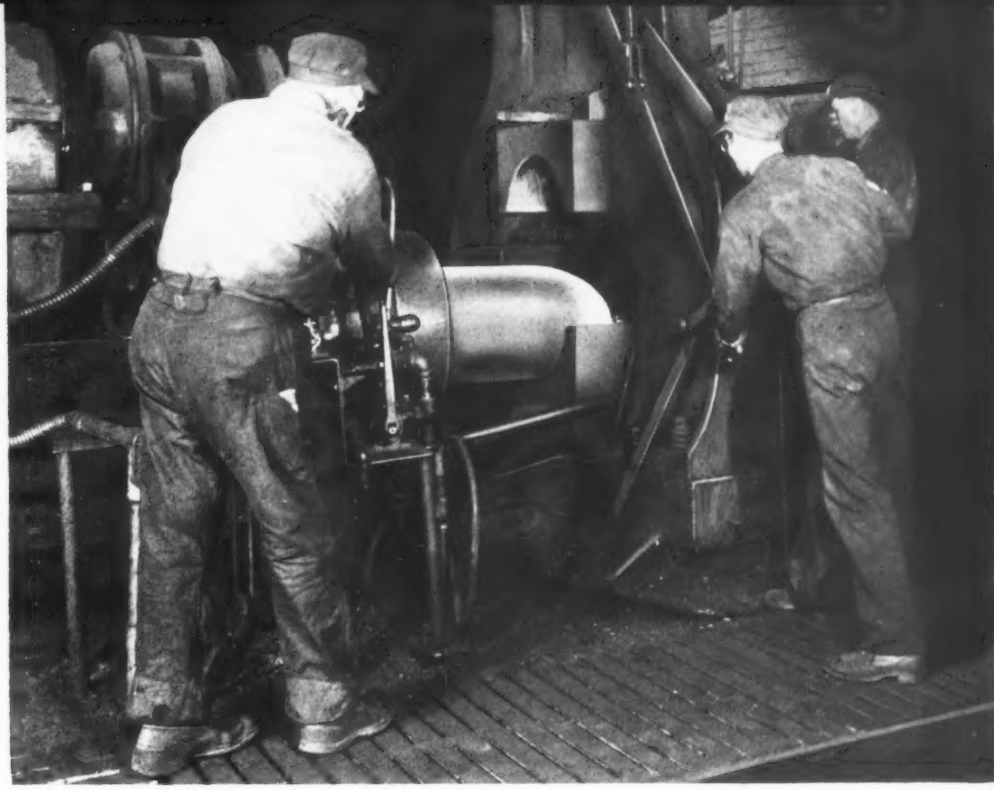


Fig. 14. (Above) Furnaces Employed for Heating the Ends of Bombs prior to the Tail Forming and Nosing Operations

Fig. 15. (Left) In Forming the Tail End, the Heated Bomb is Rotated Slowly by a Machine, and at the Same Time, is Gradually Fed Forward into the Dies of the Forging Hammer

Fig. 16. Forging the Nose is Performed in a Manner Similar to That Followed in Forging the Tail End, but Three Separate Nosing Operations are Necessary, with Reheatings between



was to insure ready handling of the bombs by the rotating machine that they were rounded in the bulldozer at the Milton plant.

After forging the nose, the bombs are heat-treated. For this process, they are first charged into a long Mahr oil-fired furnace, the discharge end of which is shown in the background in Fig. 17. The bombs roll gradually from the loading end to the discharging end as bombs ahead are removed. When they have been held at the required temperature for the prescribed length of time, the bombs are pulled out lengthwise by means of a rod equipped with a device at the front end that can be conveniently locked inside the tail end of the bombs. The bombs are pulled into a structural cage, which lies in a horizontal position on rollers in front of the furnace door.

This cage is attached to an overhead crane, and as soon as the heated bomb has been pulled into it and the furnace door closed, the crane hoist is operated to lift the cage and bomb into a vertical position. The cage is then lowered to immerse the bomb into a 6-foot deep quenching tank, as seen in the foreground of the illustration. The liquid in this tank is circulated constantly to hold the quench at a uniform temperature.

After the bombs have been lifted from the hardening quench, they are deposited on a grav-

Fig. 17. Quenching a Bomb Vertically in a Tank while Suspended in a Cage into which It was Pulled when Taken from the Hardening Furnace Seen in Background

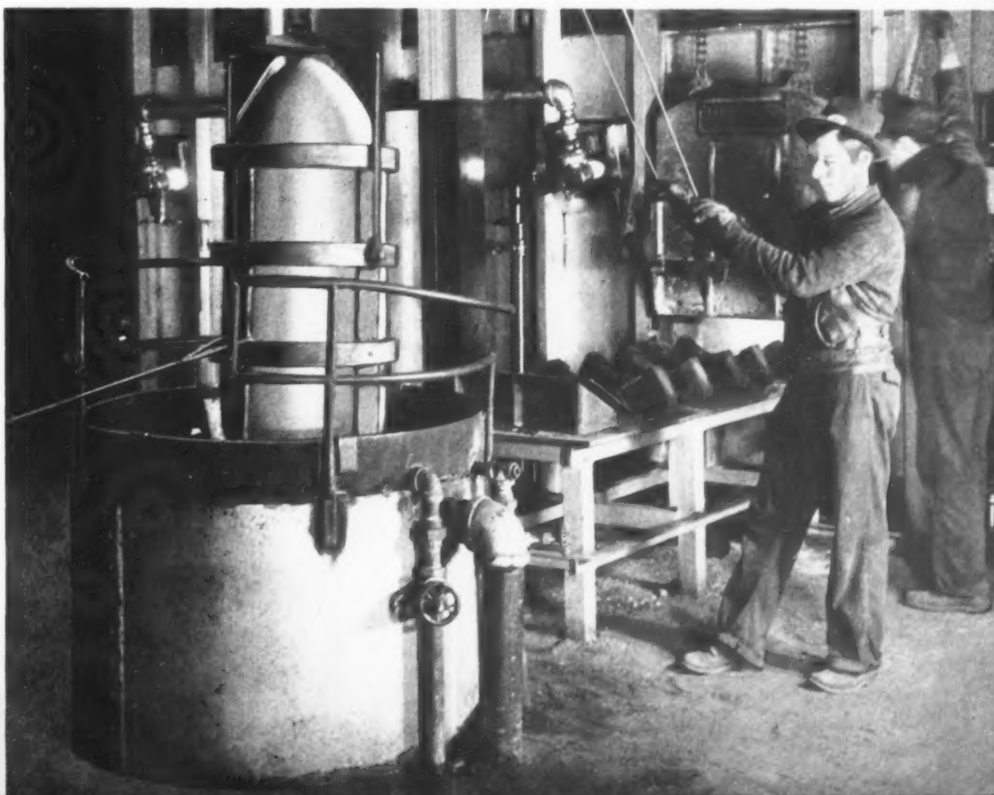


Fig. 18. Welding Suspension Lugs on the Side of a Bomb by Oxy-acetylene Method after Hardening and before Tempering

Fig. 19. Device Employed for Checking Strength of Welded Lugs in a Direction at Right Angles to the Bomb Axis

ity roller conveyor and brought to three stations where there are gas burners for preheating the bombs at points where suspension lugs are to be welded on. This lug welding operation is performed in the manner shown in Fig. 18, with the lugs held in alignment by means of a structural bracket. The photograph shown was taken before the installation of the gravity conveyor. Two bands are next clamped around the bombs temporarily to protect them during tempering, and to enable them to roll through the tempering furnace, which would not otherwise be possible on account of the suspension lugs.

After the bombs leave the tempering furnace, they are permitted to cool in air, and are then tested for quality of the lug welds. A hydraulically actuated machine is first employed to exert a pulling force of 3500 pounds on each lug

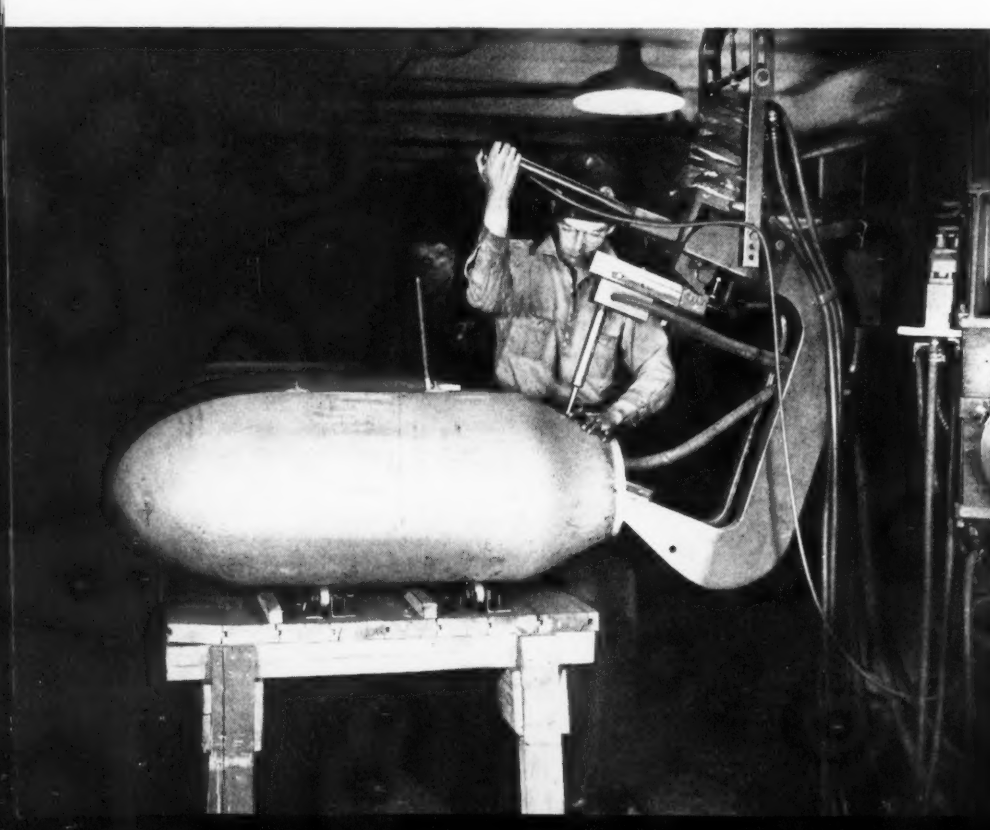


Fig. 20. Identification Plates are Spot-welded to Tail End after the Bombs have been Shotblasted Inside and Out

Fig. 21. The Bomb Nose is Drilled, Spot-faced Inside and Out, Reamed, Recessed, and Tapped on a Radial Drill

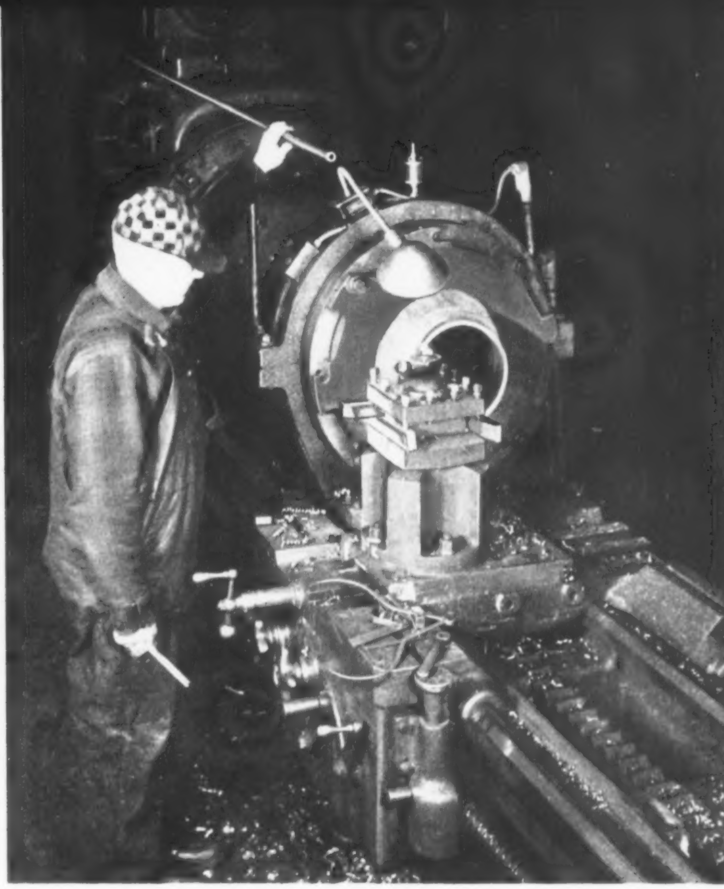
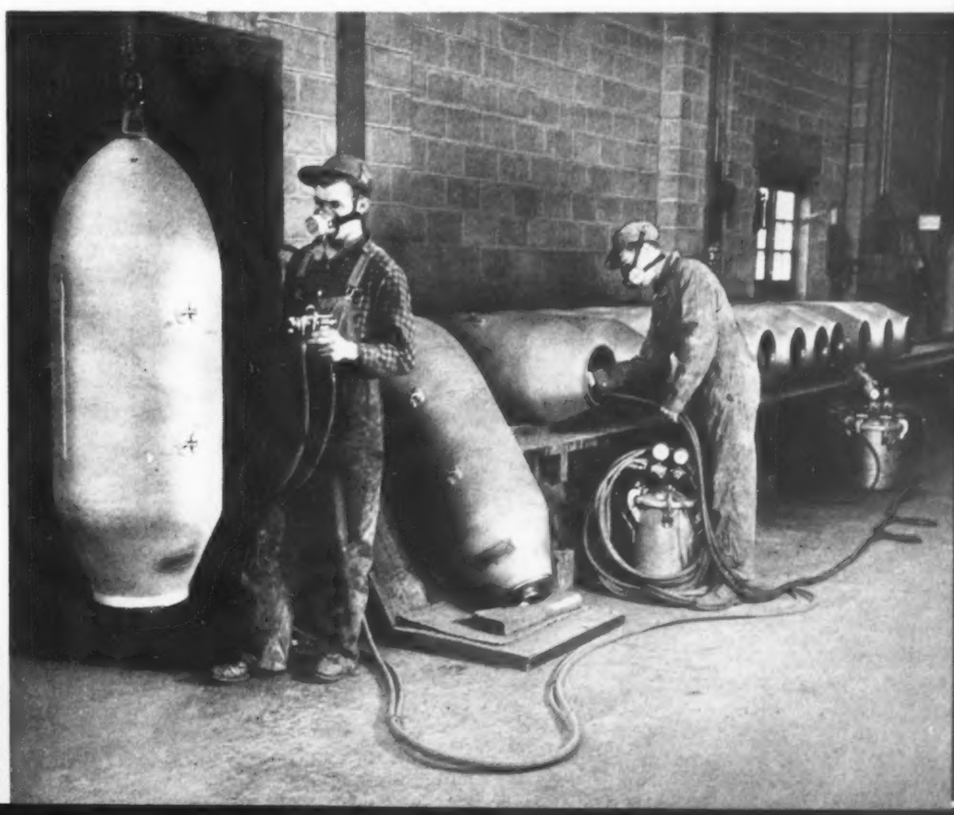


Fig. 22. An Engine Lathe is Employed for Facing, Boring, and Threading the Tail End of the Bombs

in a direction parallel to the axis of the bombs. Then another testing device, which is seen in Fig. 19, exerts a pulling force of 8000 pounds on each lug, at right angles to the bomb axis. The base of this device is hooked on each lug, and a pulling force is developed by turning the crank-handle. The force applied is registered on an air gage seen at the right.

The bombs are next passed to the radial drilling machine shown in Fig. 21, where they are mounted on an indexing fixture which is attached to one side of the table. The nose end of the bomb is drilled to a diameter of 1 25/32 inches with the bomb in the position shown, and the outside surface around this hole is spot-faced. Then the bomb is indexed through 180 degrees, and the hole at the nose end is spot-faced on the inside. The bomb is now indexed

Fig. 23. The Bombs are Coated Inside with an Acid-proof Paint, and are Sprayed on the Outside with Paint



again into the position illustrated for reaming the nose end, recessing, and tapping threads.

The bombs are next transferred to the engine lathe shown in Fig. 22, where the tail end is bored and threaded. At the time that the photograph was taken, the threads were being chased, but the present practice is to cut the threads with a collapsible tap 9 5/8 inches in diameter. The bomb is held in a large pot chuck for this operation, and driven from the suspension lugs.

Next, the bombs are completely shot-blasted on both the inside and outside with Pangborn equipment to remove all scale and dirt that might interfere with a good painting job. After the shot-blasting operation, an identification tag is fastened to the tail end of the bombs by spot-welding. This operation is accomplished by the use of a special welding head of jaw design, which enables the lower electrode to be inserted through the tail opening and against the inside of the bomb directly beneath the upper electrode, as shown in Fig. 20.

The bombs are next rolled along the platform seen in Fig. 23, and are sprayed on the inside with an acid-proof paint. This painting operation is carefully inspected by means of an electric light bulb mounted on the end of a long rod. The bombs are then rolled to the left end of the platform, where they are tilted on a short incline into an almost vertical position for convenient lifting by means of a hoist. They are sprayed externally while suspended from the hoist.

Circular bands are then again applied to the bombs for protecting them during shipment to explosive loading plants. The base plugs and nose plugs, which are machined by sub-contractors as already mentioned, are assembled to the bombs before they are shipped.

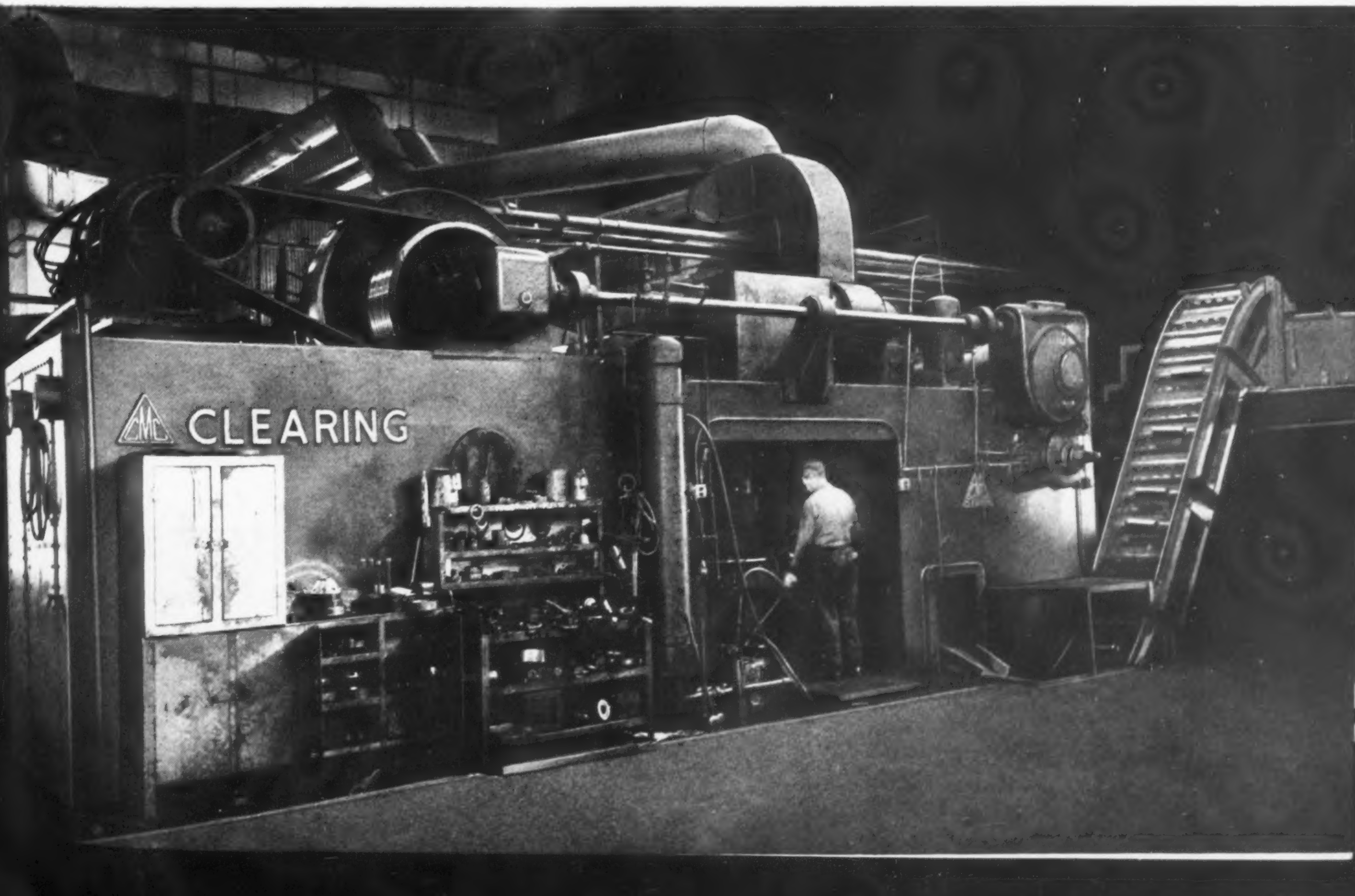
Automatic Forging

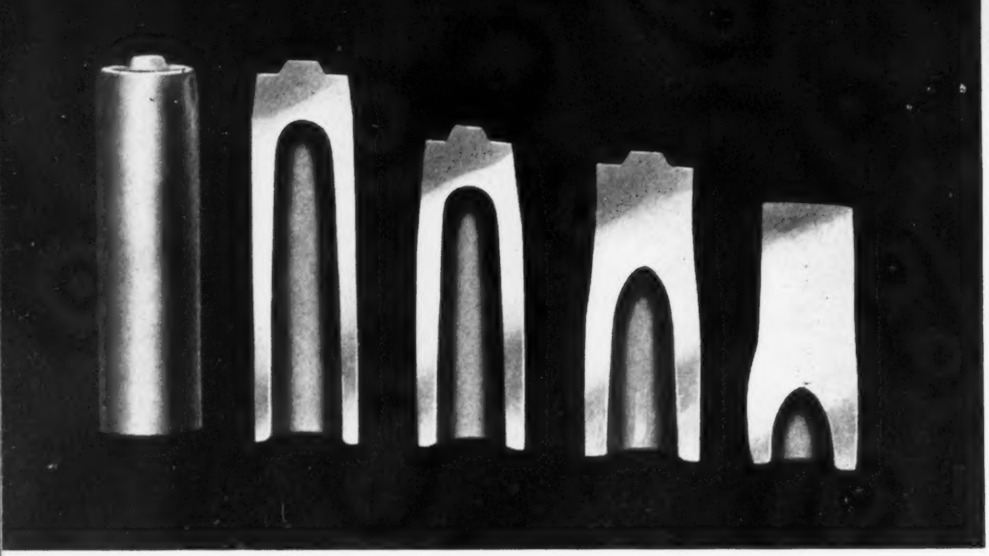
OF 90-MM. SHELLS

MORE than one million shells of 90-millimeter size have been produced by a Clearing automatic shell forging machine that is in operation at the plant of the General American Transportation Corporation, East Chicago, Ind. This machine is now being equipped with punches and dies for producing forgings for 75-millimeter shells. As this machine was described in an article published in October, 1941, MACHINERY, page 161, the present article will deal chiefly with the way in which it is used and the supplementary equipment that brings heated billets to the machine and takes away the finished forgings.

Steel for the billets from which the shell forgings are made comes to the plant as hot-rolled square bars of the required cross-section, with rounded corners. These bars are sawed into billets having the necessary weight of metal to produce the completed shell forging. As the billets are cut off, they are carried by a conveyor to the loading door of a heating furnace equipped with a rotary hearth. Between the cutting-off department and the heating furnace, the billets

General View of Clearing Shell Forging Machine, Showing Chute through which Finished Forgings are Delivered to a Conveyor System, which Takes Them to Shot-blasting Machines for Cleaning the Interior





Cross-sections of Shells, Showing Cavity Depth after Each Successive Step in the Series of Forging Operations

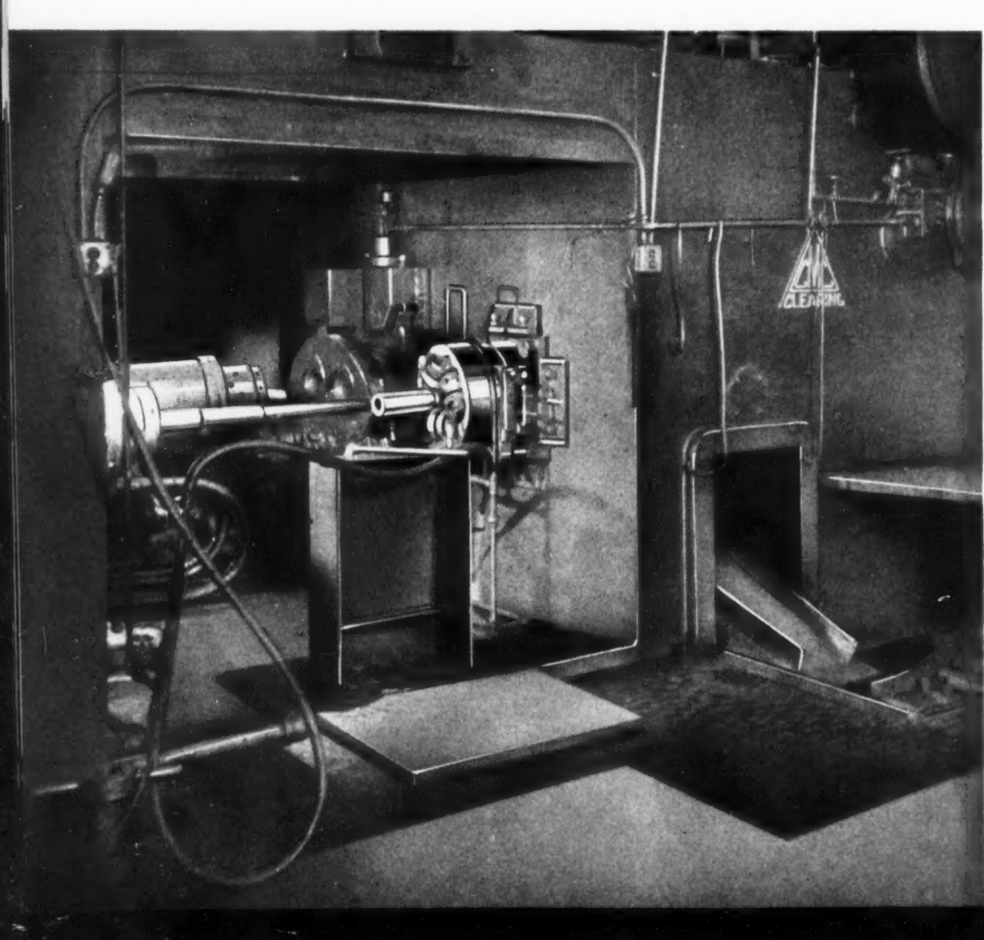
pass over a unit of the conveyor that is mounted on a platform scale. Reference to this scale makes it an easy matter to ascertain whether the billets are coming through uniform as regards the required weight.

The furnace hearth makes one revolution in thirty-five minutes, and during that period, the billets are heated to the required forging temperature. Tongs with water-cooled handles are used to lift the heated billets from the furnace and place them on a steel plate, where the scale is scraped off the sides. The descaled billets are then transferred to a loading arm, geared to the die table of the automatic forging machine. From this point on, the operation of the machine is fully automatic, with the exception that the punches which progressively form the cavity in the shell forging are manually lubricated with a colloidal graphite lubricant, which is applied with swabs. Cooling of the punches is automatically accomplished by hot water sprays, which deliver jets of water to each punch on its return stroke.

The die table indexes to bring each billet placed in the loading arm into position opposite the first, second, and third punches, which perform successive steps in piercing the cavity in the shell forging.

After the last stage in the sequence of piercing operations, the drawing mandrel enters the pierced cavity and pushes the forging through a set of roller and ring dies, which form and size the outside of the forging. When the finished forgings pass through these dies, they drop into a chute and slide onto a conveyor that carries them to an overhead cooling conveyor.

From the preceding description, it will be apparent that at each forward stroke of the ma-



Close-up View of Shell Forging Machine, Showing (Front Right) Pierced Billet about to Receive Mandrel that Enters Cavity and Pushes Forging through a Set of Roller and Ring Dies, which Perform the Final Sizing Operation

Heating Furnace, Showing One Billet as It Comes from the Furnace and a Second Billet being Descaled Ready for Forging

chine, the first, second, and third stages of the cavity piercing are accomplished on three billets, and at the same time, a fourth billet is pushed through the sizing die and onto the conveyor system.

Under normal operating conditions, three forgings an hour are removed from the conveyor and gaged. The cooling conveyor carries the forgings to shot-blasting machines, where the inside of the cavity is cleaned. From this point, the completed forgings go through the various machining operations required to finish their manufacture.

The production obtained with this automatic machine is claimed to be from three to five times higher than that obtainable with conventional types of forging machines.

The inside of the forging has the required accuracy as produced by the machine, and shot-blasting is the only finishing operation necessary. It is also noteworthy that the forgings for 90-millimeter shells run close to 3.805 inches outside diameter. By rough-turning, this diameter is brought down to 3.640 inches. It will be readily appreciated that with the necessity for removing only 0.165 inch from the outside diameter of the forgings in the rough-turning operation, this light first cut is an important factor in further stepping up production.

Close-up View of Conveyor that Carries the Shell Forgings from the Automatic Forging Machine up to an Overhead Cooling Conveyor. The Woman Seen at the Right is Gaging a Finished Forging as It Comes from the Machine

37- and 57-m

FROM PENNSYLVANIA'S C

How the Barrels for Guns Used as Aircraft, Tank, Anti-Aircraft, Anti-Tank, and Field-Artillery Weapons are Forged and Machined in a Plant Originally Built for Making Oil Field Equipment

By E. C. GRANDIN
Manager of the Ordnance Division
Struthers-Wells Corporation
Titusville, Pa.

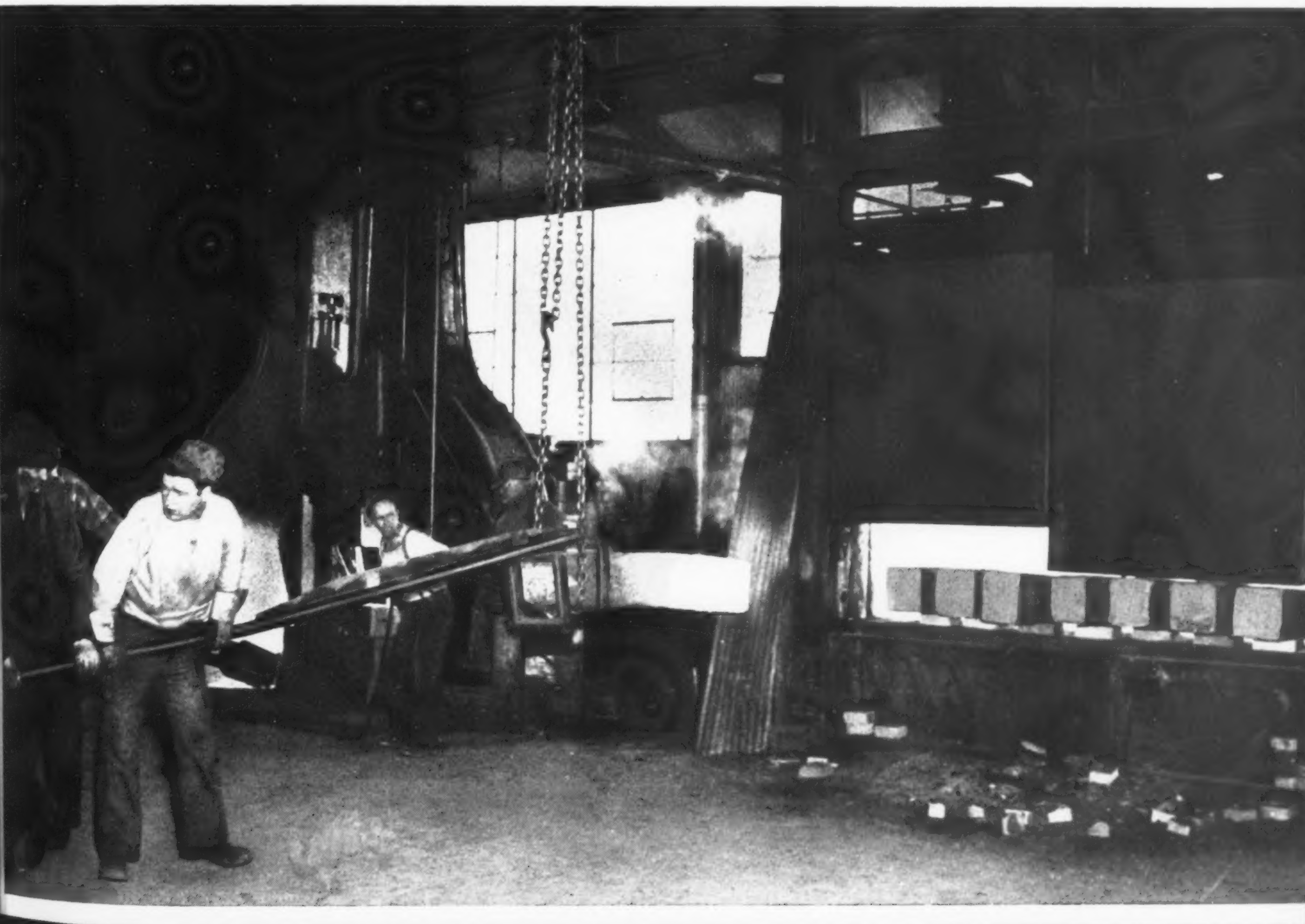
British Official Photo

-mm. Guns

S OIL COUNTRY

WITHIN one year after the discovery of oil in America and within one mile of the historic site where oil was found, there was erected an industrial plant that was the first in this country to be devoted exclusively to the production of oil pumping and refining equipment. This industrial plant, The Titusville Iron Works Co., Titusville, Pa., has expanded its regular products in the years since 1860 to include gasoline and Diesel engines, boilers, rotary lime kilns, and a considerable variety of welded and riveted work. In 1932, it became a division of the Struthers-Wells Corporation, which also operates a big forge plant at Titusville and a

Fig. 1. Removing the Billet from an Oil-fired Furnace after it has been Heated to a Forging Temperature at One End, Ready for Shaping the Breech



oto

third plant at Warren, Pa., specializing in the fabrication of stainless-steel products.

During the days of the first World War, the Titusville forge plant turned to the manufacture of the famous 75-millimeter guns. Based on that experience, the plant obtained orders for gun production even before the outbreak of the present conflict in Europe, and has for several years been engaged in forging, rough-turning, and heat-treating gun barrels of calibers from 37 millimeters to 4 1/2 inches.

In early 1940, the Titusville Iron Works plant commenced installing machine tools for finishing certain sizes of these barrels, and more recently has erected its own forge shop for forging, heat-treating, and inspecting 37- and 57-millimeter barrels by the most modern methods. The forging and finishing of gun barrels of these sizes in the "Iron Works" plant are dealt with in this article. The 37-millimeter guns are used on tanks and airplanes, and also as field artillery. The 57-millimeter guns are mounted on tanks, and are also used as anti-tank guns.

Gun barrels are ordinarily forged from electric furnace steel supplied in rolled billets by the steel mills, but in these days of great demand for raw materials, it is often impossible to obtain rolled billets. In such cases, gun-barrel production starts directly from the ingots. Fig. 2 shows several piles of ingots as they are received from the mills, with the risers still on them. They are cogged under heavy presses at

Fig. 2. Piles of Ingots that are to be Forged into Aircraft, Tank, Anti-tank, and Field-artillery Guns

Fig. 3. Preheating Billets to a Temperature of between 1250 and 1300 Degrees F. in Car Type Oil-fired Furnaces

the forge plant to approximate billet size, and then sent to the forge shop of the Iron Works.

Here the billets are loaded on flat cars such as seen in Fig. 3, and pushed into preheating furnaces. The tops of the cars serve as a hearth for the furnaces. The billets remain in the furnaces from eight to twelve hours, at the end of which time they have attained a temperature of between 1250 and 1300 degrees F. The furnaces are about 18 feet deep, and are each heated by five oil burners, arranged along one wall near the top. The flames are directed against the opposite wall rather than downward toward the charge.

Upon removal from the preheating furnaces, the billets are transferred to heating furnaces of the type seen in Fig. 1, which are located adjacent to forging hammers of various sizes. In the case of billets for 57-millimeter gun barrels, the end of the billet to be forged first is inserted in the furnace, the opposite end being permitted to extend beyond the door. The billets for 37-millimeter gun barrels can be completely enclosed in the furnaces. These furnaces are oil-heated, and bring the billets up to a temperature of about 2200 degrees F. The billets are loaded and unloaded by means of special handling devices, supported by a traveling crane. This support is necessary because of the fact that a billet for a 57-millimeter barrel is 10 inches square in cross-section by 63 inches long, and has a weight of approximately 1700 pounds; the billet for a

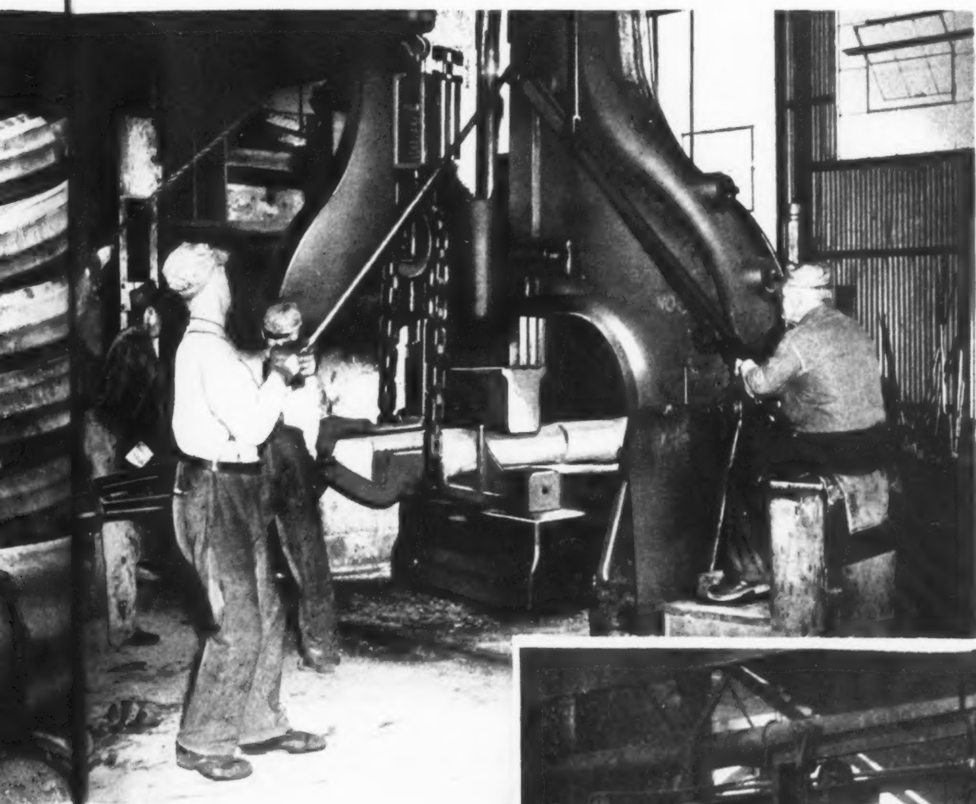
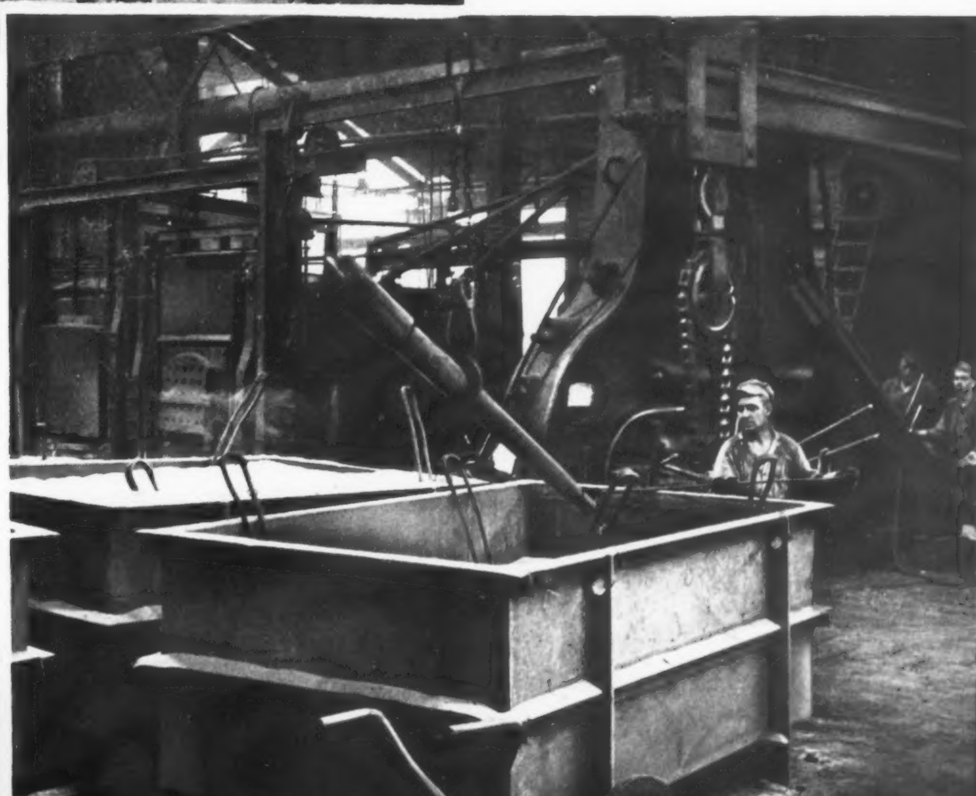


Fig. 4. Hammering a Heavy Billet into a 57-millimeter Gun Forging under a 6000-pound Steam Hammer

Fig. 5. After Forging, the Gun Barrels are Embedded in Boxes of Fuller's Earth for a Slow Annealing Process



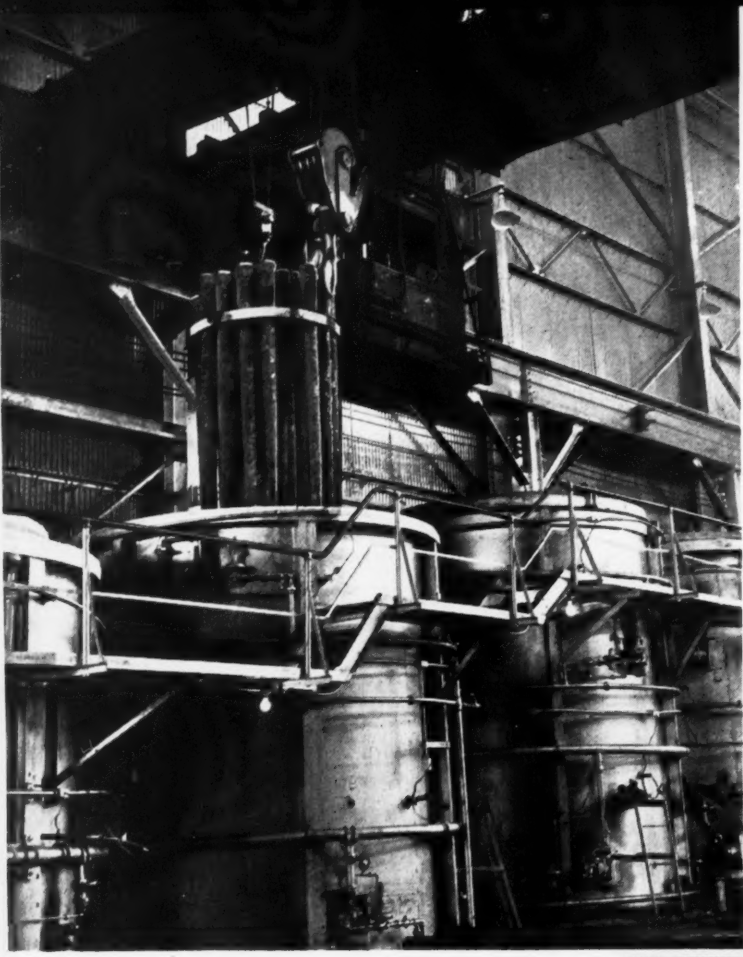


Fig. 6. Gas-fired Furnaces of Vertical Construction Heat the Gun Barrels Three Times during the Course of the Heat-treating Process

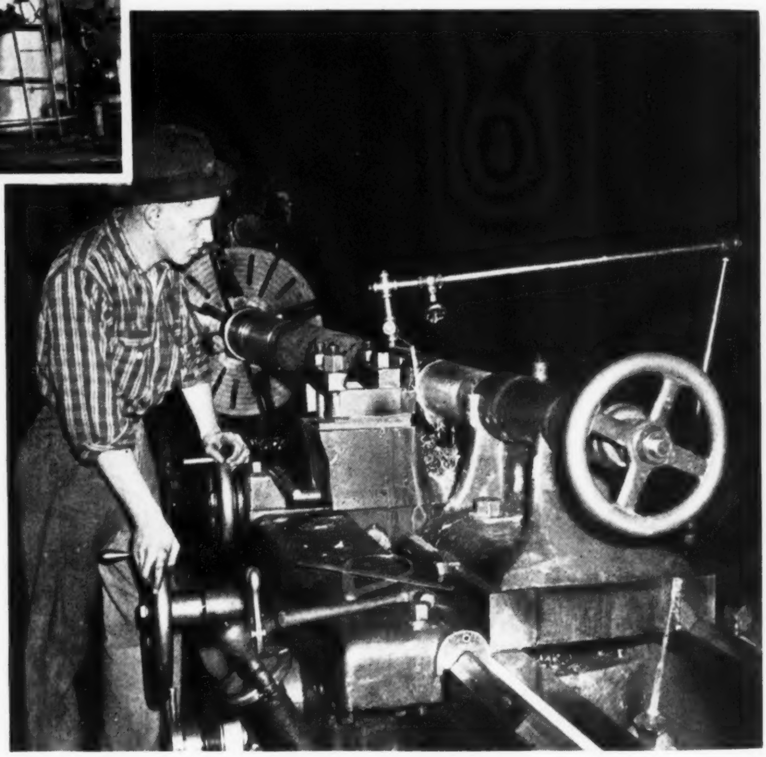


Fig. 7. 57-millimeter Gun Barrels are Completely Rough-turned prior to Heat-treatment

37-millimeter barrel weighs about 560 pounds. It usually requires four men to swing the billet for a 57-millimeter gun barrel from the furnace to the forging hammer.

A forging operation on a 57-millimeter gun barrel is seen in Fig. 4 being performed under a 6000-pound Erie steam hammer. On operations on this size of gun barrel, the practice is to heat and forge the breech end first, and then return the partly formed forging to the furnace for heating the muzzle end. The breech end is forged on all the billets of one heat, and then the muzzle end is forged in the same succession. With this arrangement, the billet on which the breech end was first forged will be sufficiently heated on the opposite end for forging the muzzle by the time that the last billet has been forged on the breech end. When completed, the barrel forging for a 57-millimeter gun is about 10 feet in length. A serial number is stamped on the gun barrel by the steam hammer for identification purposes.

From the forging hammers the gun barrels are immediately transferred to steel boxes such as seen in the foreground in Fig. 5, and completely embedded in fuller's earth. They are laid in rows on top of each other, with a generous layer of fuller's earth between them. The barrels are left in these boxes for ten days to insure thorough annealing, and are still warm upon removal. This slow anneal is an important factor in satisfactory gun-barrel production. When it is not carefully observed, checking of the steel will occur. All of the gun barrels in one box are lifted together at the end of the cooling period by attaching a traveling crane to a skid placed in the bottom of the boxes before they are loaded.

The barrels for 57-millimeter guns are next rough-turned in engine lathes. Fig. 7 shows a

typical operation in progress. The barrel is turned straight to several diameters with the muzzle end held in the headstock. Then the forging is transferred to another lathe equipped with a taper attachment for taking a second cut. In the first or "hogging" operation, cuts are taken to depths of from 1/8 to 5/16 inch at a speed of approximately 50 feet per minute, with a feed of 0.045 inch, by the use of high-speed steel tools. The carbide tools that are employed for the second cut remove stock to a depth of about 1/16 inch at a speed of approximately 100 R.P.M.

After this turning operation, the 57-millimeter gun barrels go to loading pits in the forge shop, about 9 feet in diameter by 14 feet deep, which

Fig. 8. Lowering a Batch of Gun Barrels into Oil Quenching Tank in which They are Held until their Temperature Drops from 1600 Degrees F. to between 200 and 250 Degrees

Fig. 9. Pieces of Square Cross-section are Cut by Band Saws from the Ends of Gun Barrels for Checking the Physical Characteristics

are provided with a sturdy upright column in the center. A large circular steel casting or spider is placed horizontally on top of this column to receive a group of gun barrels for the heat-treating process. This spider is cast with holes into which the gun barrels are loaded individually by a crane. The spider for 37-millimeter barrels can accommodate thirty barrels at one time, and the spider for 57-millimeter barrels, sixteen barrels at one time. The 37-millimeter barrels are brought to these loading pits directly after removal from the fuller's earth.

Spiders loaded with gun barrels are taken from the loading pits by crane to adjacent gas-fired furnaces of vertical construction, as seen in Fig. 6. The interior of these furnaces measures 9 feet in diameter by 14 feet high. The barrels for 57-millimeter guns are heated in these furnaces to a temperature of 1650 degrees F., which requires six hours, and they are held at that temperature for a period of eight hours in the first step of a normalizing process. They are then removed, and the entire batch of barrels, still suspended from the spider, is placed

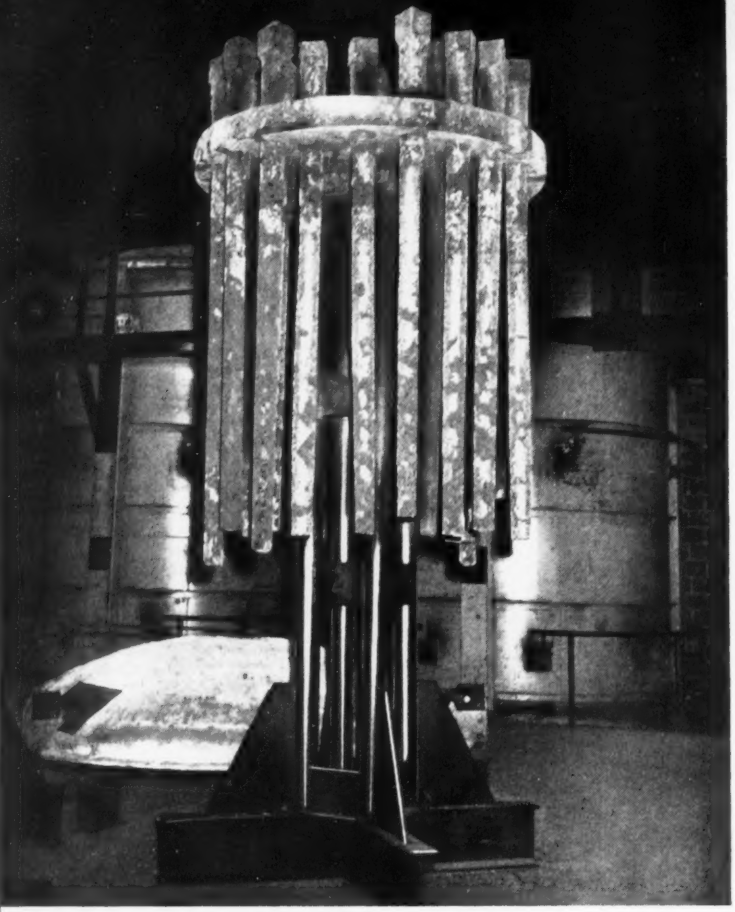


Fig. 10. After Final Heat-treating Operation, the Barrels are Left Suspended on Vertical Columns for Cooling in Air

in a loading pit to cool in still air. After two hours' time, the temperature of the barrels has dropped to approximately 800 degrees F. They are then returned to one of the vertical furnaces.

The barrels are reheated a second time to a temperature of 1600 degrees F. in a period of approximately twelve hours, and are held at that temperature for eight to ten hours. They are now quenched in oil in the large tank seen in Fig. 8, which is about 20 feet deep. The quench oil is circulated constantly through a cooling system to keep its temperature down. Each batch of gun barrels is held in the quench until their temperature has dropped to between 200 and 250 degrees F. They are then loaded into the vertical furnace for a third time and heated to a temperature of between 1000 and 1100 degrees F. This temperature is reached within a period of from twelve to fifteen hours. The guns are held at that temperature for approximately ten hours.

Still suspended from the spider, the guns are next placed on top of a structural stand in the open atmosphere of the shop, as shown in Fig. 10, for final cooling in air. The entire cycle of heat-treatment requires about seventy-two hours. All furnace temperatures are carefully controlled by Brown recording potentiometers. There are two potentiometers for each of the vertical furnaces. One instrument records and controls the temperature at the bottom of the furnace, and the other at the top.

Upon the completion of the heat-treating process, all gun barrels go to the metallurgical department, which is also located in the forge shop, for a determination of physical characteristics and chemical analysis. Thin sections are cut from the ends of the forgings for these investigations by Marvel high-speed ball-bearing saws, such as seen in Fig. 11, and specimens of

Fig. 11. View of the Metallurgical Department, Showing a Battery of Sawing Machines Employed for Cutting Specimens from Barrels

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Fig. 12. (Right) Cutting a 57-millimeter Gun Barrel Forging to Length and also Obtaining Plates for Checking Physical Properties

Fig. 13. (Below) Stacking the Gun Barrels Vertically while Metallurgical Examinations are in Progress Enables Any Specific Barrel to be Quickly Located

Fig. 14. Rough-turning the Tapered Section after the Gun Barrel has been Laid out, Centered, and Spot-turned

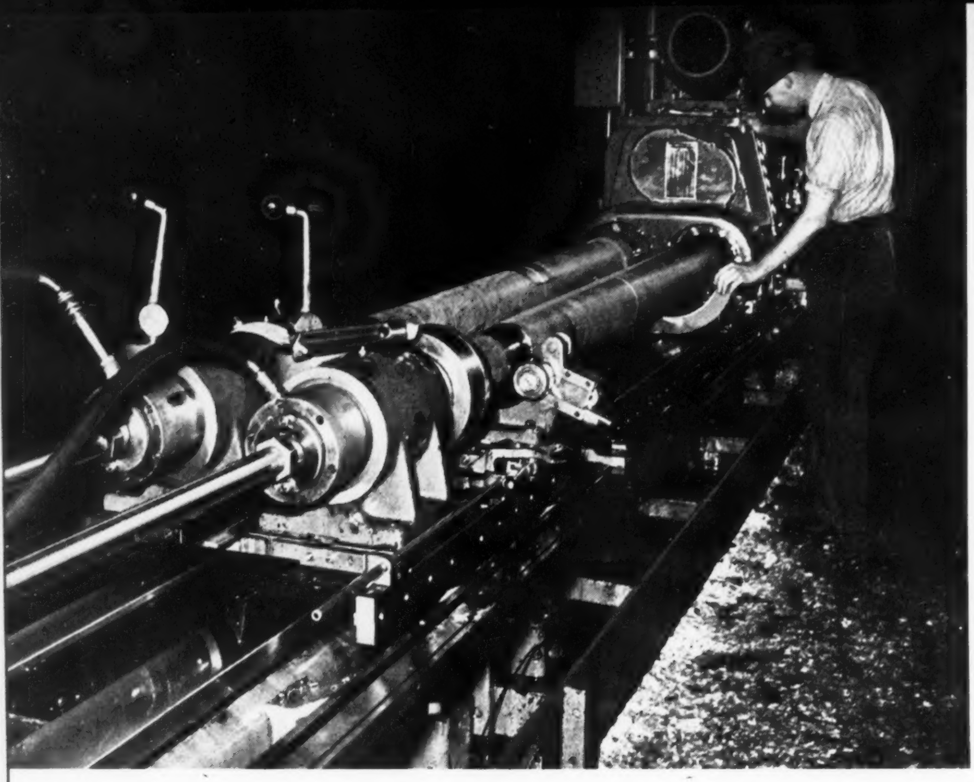

Fig. 15. The Gun Barrels are Drilled the Full Length from the Solid in Machines Designed to Handle Two Barrels at One Time

square cross-section are also cut off, as indicated in Fig. 9, by tilting band saws. Barrels of 37-millimeter guns are seen in these illustrations, while Fig. 12 shows a slab of material being cut from a 57-millimeter gun by a Racine hydraulic shear cut saw.

During the tests conducted by the metallurgical department, the gun barrels are stacked vertically at one side of the shop, as shown in Fig. 13, so that any barrel that does not come up to specifications can be quickly found. If the barrels were piled on the floor for these tests, much time would be lost in locating the ones that did not meet the requirements. The barrels that do not come up to the specifications are returned to the heat-treating department and again run through the heat-treatment.

The gun barrels that pass the inspection are sent to the machine shop for finishing. The procedure on 57-millimeter and 37-millimeter barrels differs but slightly, that employed on 57-millimeter barrels being described here. The first step consists of laying out and centering the ends. Then two narrow widths or "spots" are turned to provide a supporting surface for a steadyrest in succeeding operations and a good gripping surface for the headstock jaws.

Following the spot-turning, the gun barrels are rough-turned in Monarch engine lathes, a typical operation being illustrated in Fig. 14.

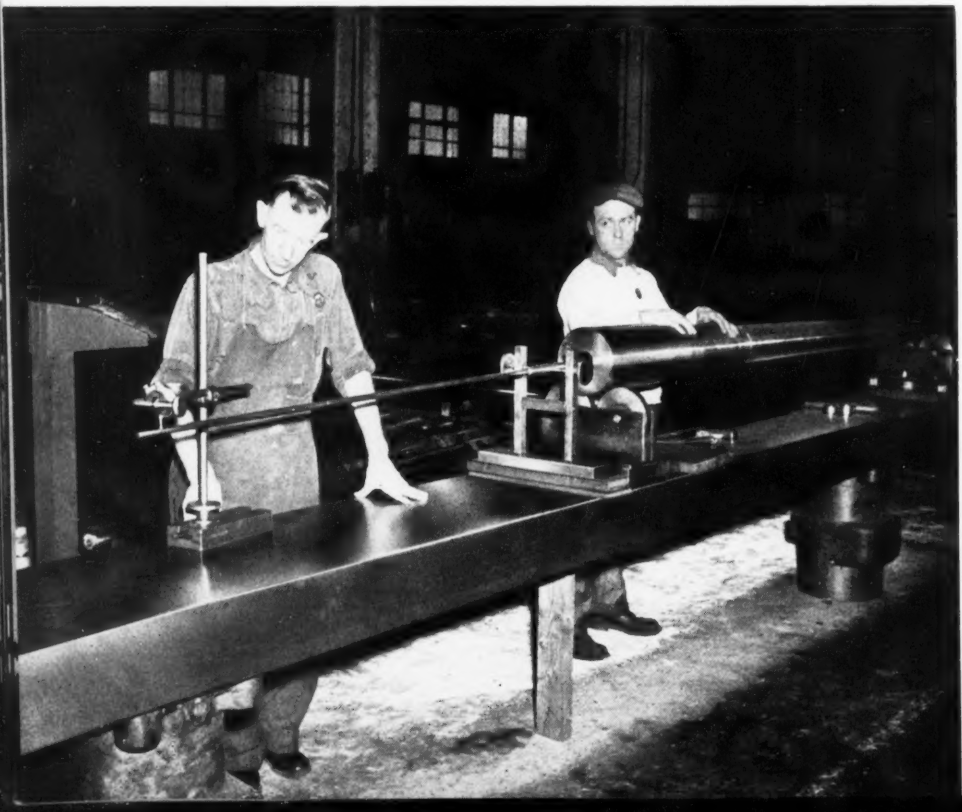

Fig. 16. Checking the Straightness of a Gun Bore by Means of a Long Feeler Gage, Applied at Seven Different Points along the Bore

Fig. 17. Applying a 250-ton Hydraulic Press to Straighten a Bore According to Readings Taken in the Manner Illustrated in Fig. 16

In this operation, which consists of turning the tapered portion only and no straight cylindrical surfaces, the desired angle of taper is obtained by applying the taper attachment at the back of the bed. Two cuts are taken. In the first, stock to a depth of 5/32 inch per side is removed, using carbide-tipped tools running at approximately 110 R.P.M.

The barrels are drilled from the solid for the full length in W. F. & John Barnes duplex machines, such as illustrated in Fig. 15, which enable two barrels to be handled simultaneously. Drills 2 inches in diameter, of a two-fluted design, as indicated by the drill lying on top of the carriage, are used. Cutting oil pumped through rubber hose connected to the carriage is emitted from holes in the drill lands. It washes the chips effectively from the drill bits, back along the flutes, and through 1-inch holes in the drill shank into hollow bars which extend to the right-hand end of the machine. Here the oil and chips are discharged into the bed pan. A pressure of 75 pounds per square inch is maintained on the cutting coolant. The drills are guided in bushings having an outside diameter of 12 inches to insure adequate support.

During drilling, the carriage is fed hydraulically toward the headstock at a rate of 7/8 to 1 inch per minute. The gun barrels are revolved at about 85 R.P.M. The long drill bars are sup-

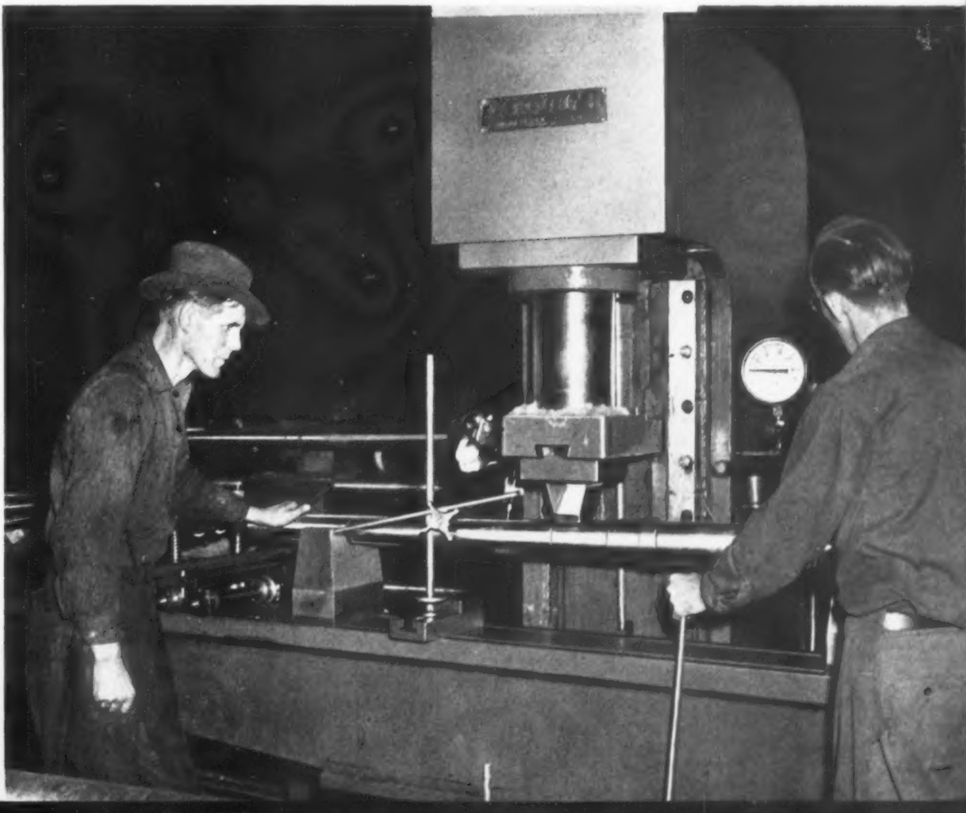

Fig. 18. A Hydraulic Press of 50-ton Rating is Employed for Straightening Gun Barrels of the 37-millimeter Size

Fig. 19. Rough-turning the Gun Barrel to the Required Contour at the Breech End by the Use of a Templet Mounted at the Rear of the Lathe

ported by steadyrests, which move forward at one-half the feeding rate of the carriage; thus the steadyrests are always midway between the carriage and the unit that holds the rear end of the drill bars.

After being drilled, the gun barrels go to American Pacemaker 24-inch lathes, tooled up, as shown in Fig. 19, for turning the irregular form and straight section near the breech end. The proper contour is obtained through the use of a templet at the back of the bed, which feeds the tool-slide crosswise as the carriage moves longitudinally along the bed.

The gun barrels are next checked for straightness in a set-up such as shown in Fig. 16. A feeler on one end of a long bar is successively brought in contact with the inside of the gun bore at seven different points. The long bar is permitted to swivel on a stand near its middle and its opposite end is contacted by the spindle of a dial height gage. With the feeler in each of the seven locations, the gun barrel is revolved several times on the rollers on which it is supported. Thus, any inaccuracies in the straightness of the bore, and the location of such inaccuracies, can readily be determined.

The gun barrels are then straightened in accordance with these readings on the Farquhar 250-ton hydraulic press shown in Fig. 17. The gun forging is supported at both ends by V-blocks and rollers of carriages that are adjustable along the bed by ratchet mechanisms. The column of the machine, with the hydraulically-operated ram, can be moved to any position along the gun barrel by means of a rack and pinion drive, for applying pressure where necessary. Gun barrels of the 37-millimeter size are straightened under the Farquhar 50-ton hydraulic press shown in Fig. 18.

The gun barrels go next to Monarch lathes equipped with automatic sizing devices, as seen in Fig. 20, for semi finish-turning. Both the diameters and the changing contour of the external surface are machined concentric with the straightened bore through the use of the automatic sizing devices. Carbide-tipped tools cut

Fig. 20. The Gun Barrels are Semi Finish-turned on Engine Lathes Equipped with Automatic Sizing Devices

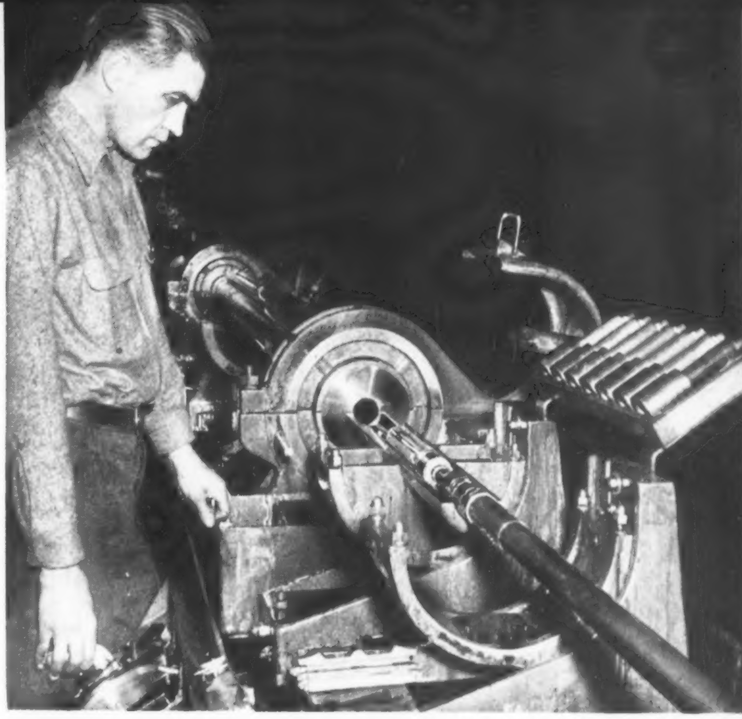

Fig. 21. Honing a Gun Bore to the High Degree of Finish and Close Dimensional Accuracy Required before Rifling can be Performed

to a depth of 1/8 to 5/32 inch per side at a speed of approximately 105 R.P.M. in this operation, leaving sufficient stock for the final turning operation.

The gun barrels are now finish-bored or reamed in W. F. & John Barnes machines similar to those employed for drilling. A typical reaming operation is shown in Fig. 22. Wood-packed reamers such as are seen on top of the carriage are used to insure bores of exceptional accuracy. The construction of these reamers is clearly shown in Fig. 23. It will be seen that two cutter bits are mounted at the front end of a long, flat steel bar which is attached to a round shank. Long sections of a hard wood turned to a diameter slightly larger than the gun bore being finished are fastened to opposite sides of this steel bar. These wood "packs" serve to hold the cutter bits steady and to guide them in accordance with the straightened bore.

Two passes are taken with the wood-packed reamers the full length of each bore. About 0.223 inch of stock on the diameter is removed in the two passes, leaving from 0.015 to 0.018 inch of stock for removal by honing. Coolant supplied through the hollow reamer bar flushes the chips out of the gun bore ahead of the reamer bits. The reamers are approximately 18 inches long. As in the drilling operation, heavy bushings on the carriage guide the tools accurately at the start of the cuts. The reamers are advanced at the rate of about 1 inch per minute, with the gun barrels rotating at a speed of 62 R.P.M.

After reaming, the gun barrels are returned to the straightening press for rechecking and correcting any inaccuracies. The barrels are then turned true with the reamed bore in Monarch lathes, also equipped with automatic sizing devices. In a succeeding operation performed on American lathes, the guns are again faced and turned on the breech end. The bores are then honed; Fig. 21 shows such an operation being performed on a W. F. & John Barnes machine. From 0.015 to 0.018 inch of stock on the diameter is removed in from two and a half to

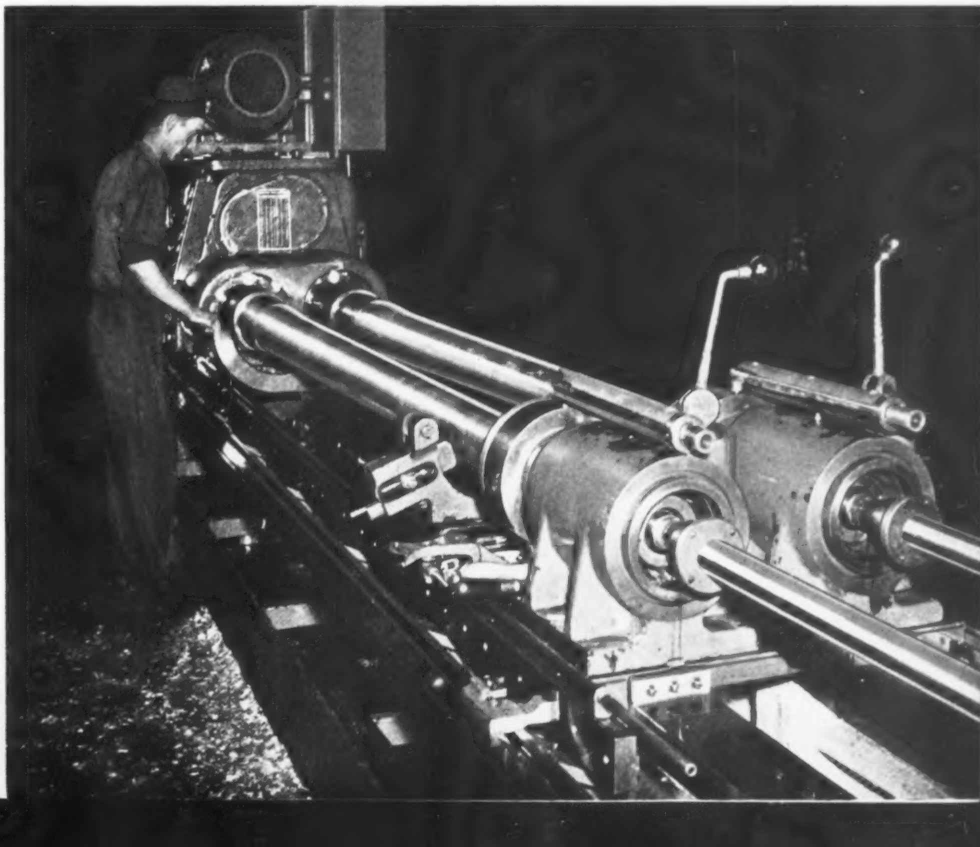

Fig. 22. Before Final Turning Operation, the Gun Bores are Reamed by Using Long Wood-packed Tools

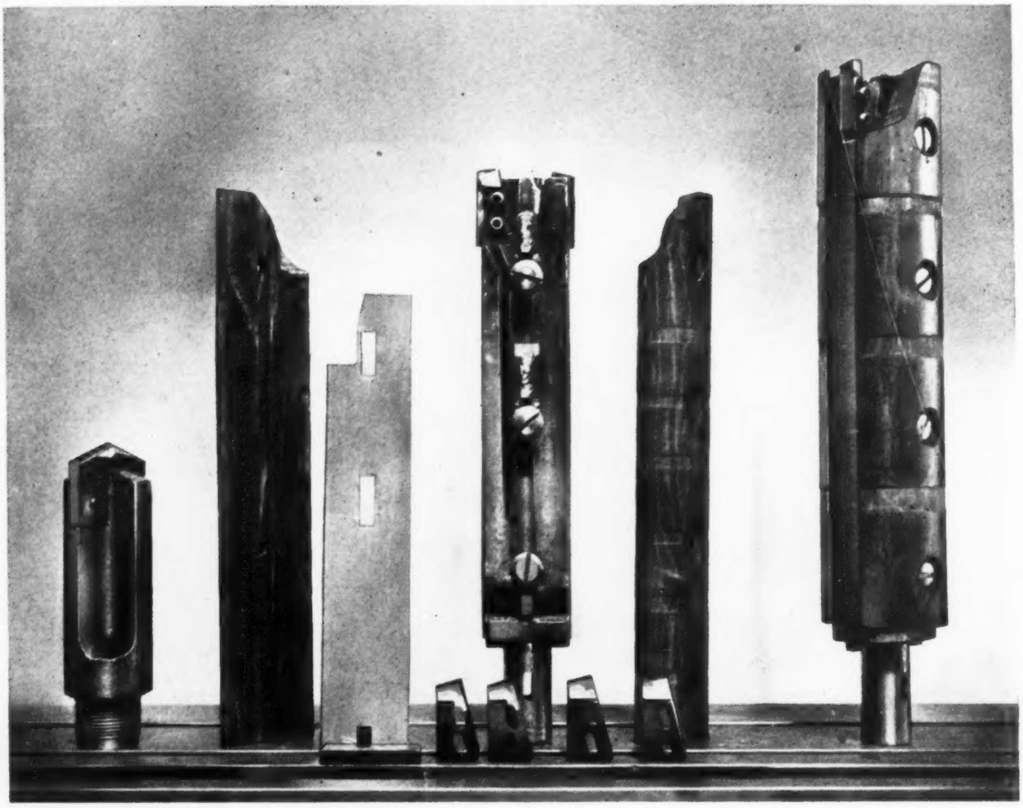

Fig. 23. Construction of the Wood-packed Reamers Used in Machining the Bore of Gun Barrels to the Honing Size

three hours. Periodically, the operator applies brass plug gages from the set seen at the rear of the machine to determine how much more stock must be removed in order to bring the bore to size.

To prevent the gun barrel from heating up, coolant is delivered to the hone from both ends of the bore, and in addition, coolant is discharged on the external surfaces of the gun barrel from a perforated pipe on top of the machine which extends the full length of the barrel. The honing head is provided with four abrasive stones. When a gun forging leaves the honing operation, it must be true as to diameter and straight within 0.002 inch for the entire length. Straightness is finally checked by moving a plug gage, 1 foot long, the entire length of the bore.

Both the 57- and 37-millimeter guns are rifled by other concerns, who also assemble the breech mechanisms. The practice of the Yoder Co., Cleveland, Ohio, in rifling the 57-millimeter gun barrels and in performing other finishing operations will be described in a coming number of MACHINERY.